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Conditionals in dynamic syntax

Gregoromichelaki, Eleni

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Conditionals in Dynamic Syntax

Eleni Gregoromichelaki

King's College London

2006

Thesis submitted in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy



Abstract

The topic of this thesis is to propose a general framework for the processing of expressions whose interpretation involves quantification over entities commonly referred to as situations or eventualities. The account is based on the formal apparatus defined in the framework of *Dynamic Syntax* (DS, Kempson et al. 2001, Cann et al. 2005) for the processing of nominal relative clauses. As a case study for this type of analysis, we concentrate on natural language *conditionals*.

One of the characteristic features of DS is its modelling of *anaphoric* phenomena by means of re-employing previously constructed terms as replacements for the underspecified content provided by anaphoric expressions. In the present account, this feature is exploited in order to explain the semantic representational effects associated with the processing of conditional sentences: a newly introduced term constructed by processing the protasis is copied into the structure induced by the processing of the apodosis in order to serve as a component of its parameters of evaluation. A few consequences follow from this analysis. It is shown that the rules developed for the handling of left-dislocation phenomena in DS can adequately account for the variable linear positions occupied by *if*-clauses. Therefore several phenomena which previous accounts attribute to properties of multiple structural representations can now be reanalysed as the effects of the time-linear process of deriving an interpretation incrementally from a natural language string. The reanalysis of the data has also led to the conclusion that the effects explained by *Binding Theory* in other frameworks should be expressed in different terms accommodating gradual availability of information at different parsing stages. The DS time-linear account of anaphora faces the challenge posed by the existence of *cataphoric phenomena* and conditionals are an important testing ground for the analytical resources of the framework in this domain. It is argued here that

such cataphoric effects are associated with special processing conditions which can be formally defined in accordance with fundamental DS assumptions. Finally, the issue of *Quantificational Subordination* is examined under the light of novel data and an account is offered of how it should be treated within the DS framework.

Acknowledgements

I would like to take this opportunity to convey my gratitude to a number of people without whose help and support this thesis would never have been possible: It is difficult to overstate my debt to my supervisor, Ruth Kempson without whose patience, enthusiasm and broadness of perspective this thesis would never have started, much less finished. With her inexhaustible energy she was always there to provide encouragement, guidance, plenty of ideas and support. Her contributions to this thesis are so many that I have been unable to acknowledge them at each particular point. In addition, I owe a great deal to Wilfried Meyer-Viol who provided a lot of sound advice and help with formal issues and am indebted to Ronnie Cann and Lutz Marten for valuable suggestions and discussion of crucial issues. I would also like to thank Professor Karen Sparck-Jones for help with copyright and referencing issues regarding internet search results.

I would like to thank the many people who have taught me Linguistics with enthusiasm and inspiration, especially: Ad Neeleman, Neil Smith, Dick Hudson, Deirdre Wilson, Mary Lou Grimberg, Shalom Lappin, Jonathan Ginzburg and Georgia Catsimali.

I am grateful to all the participants at the DS seminar who have provided invaluable support, information and enjoyable company: Miriam Bouzouita, Ronnie Cann, Justin Charity, Jieun Joe-Kiaer, Lutz Marten, Shin Okajima, Masayuki Otsuka, Nhlanhla Thwala and Hiroyuki Uchida. Especially I wish to thank Udo Klein for many stimulating discussions of linguistic issues.

I also would like to thank my friends and colleagues from King's and UCL who made my time there fruitful and enjoyable: Sam Martin, Dimitra Papangeli, Kriszta Szendroi, Vina Tsakali, Ivan Garcia-Alvarez, Matt Purver, Raquel Fernandez, Jamie Gabbay, Christian Ebert and Ulle Endriss.

I am financially indebted to the Humanities Research Board of the British Academy for my Ph.D. studentship.

I wish to thank my family: my parents and my brother for their love, support and patience. Lastly, and most importantly, I would like to thank Berdo who has been a constant source of strength, comfort and reassurance for all these years.

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CHAPTER 1

INTRODUCTION

1. Aims of this Study

This dissertation has two main goals. Firstly it is an exercise in extending a fairly new framework for syntactic analysis, *Dynamic Syntax* (DS, Kempson et al. 2001, Cann et al. 2005), to the domain of interpretations that involve reference to abstract entities like worlds, times and situations. Defined more narrowly, the more specific concern of this thesis, taken as a testing ground for the resources of the framework, is natural language *conditionals*. DS takes an innovative perspective in approaching linguistic analysis in that linguistic phenomena are approached from the point of view of the parsing mechanism. As a result, the mode of explanation for the relevant phenomena is presumed to crucially include the dynamic nature of constructing representations of interpretations, *logical forms*, for incoming linguistic strings. This means that, in addition to the traditional static representations exploited as explanatory devices in other frameworks, DS also integrates the modelling of the hearer's parsing task as a source of providing answers to syntactic puzzles. The modelling of this task which is arguably conducted in successive stages, necessitates the characterization of the partiality of information available at each parsing stage and the definition of the alternatives open for further processing. This provides the basis of explanation for the left-right asymmetries observed in the structuring of linguistic strings: because the hearer's parsing task is taken as the basis of the model it is naturally expected that the presentation of the message will be adjusted in order to take into account the hearer's variable state of information at the point in the parsing task currently being conducted. A related central property of DS is its commitment to modelling the radical context dependence of natural language and the way in which interpretation is built up relative to context. This means, as we shall see in detail, that the linguistic/grammatical specification of words

or structures may significantly under-specify the assigned interpretation. This is because the resolution of underspecified information is taken to be provided either by the context, or during the interpretation process. In particular, DS commits itself to an account of anaphoric expressions as contributing specifications that under-determine the particular interpretation that is assigned to them in context, following the general spirit of *Relevance Theory* (Sperber & Wilson 1986/1995). This approach, as a tool for linguistic analysis, has the consequence that syntactic restrictions and variable types of interpretation can be given a unitary basis of explanation. Moreover, since in actual human parsing distinct types of information have been shown to interact on-line, DS is designed in such a way as to provide points of interface between the operation of the grammatical formalism (*syntax*) and other types of information (*context*) jointly deriving the output of the parsing task which must be a complete and fully disambiguated logical form. In the domain of conditionals where inherent vagueness and context dependence of interpretation has been noted by various researchers, a sensible method of analysis is suggested by this methodology integrating both the contribution of the context of processing and what is given explicitly by the linguistic system. There are multiple analyses of conditionals which attempt to classify the disparate interpretations derived by the processing of syntactically identical linguistic strings (see e.g. Declerck & Reed (2001) who identify a multitude of semantic interpretations). An account in the spirit of DS ought to allow such a multiplicity of interpretations arising from the processing of a single conditional sentence to be derived not as directly encoded in the linguistic system but as the effect of inherent context dependence. Similarly to the DS account of anaphora (and indeed *Relevance Theory*) the challenge is to identify a suitably underspecified encoded content which can then be enriched by input from its context of occurrence in order to provide the requisite interpretations. Since it seems to be case that the more and more data considered the more and more interpretive possibilities must be postulated in any classification it seems essential that the syntactic analysis must be unburdened from the task of enumerating all these options (while

nevertheless seeking to retain a uniform basis for interpretation at some level of abstraction). This is the point of view from which conditional sentence processing will be examined in this thesis, namely, we will not attempt to derive every possible interpretational effect ever observed as encoded in the semantics of a conditional utterance but rather attempt to provide the minimal skeletal form which further processes of reasoning and pragmatic processes will take as input in order to derive the requisite interpretations.

A second aim of this thesis emerging as a result of the DS stance taken above is to attempt an explanation of how the processing of the linguistic input provided by natural language conditionals results in the circumscription of local structural domains that allow or disallow anaphoric dependencies among terms introduced at different parsing stages. Because of the nature of the DS formalism this is essential for the appropriate functioning of the system since the expressed aim is not only the characterisation of possible and impossible strings but also the provision of constraints that restrict the operations of the inferential mechanisms which are assumed to interface with the grammar. In that respect the aims of DS are similar to those of more established frameworks like DRT (Kamp 1981, Heim 1982) which also attempt to characterise the interaction between semantic interpretation and context dependence. However, the classical articulations of the latter frameworks require the intermediate stage of a syntactic representation which is established independently of the processing for discourse representation purposes. In contrast, DS integrates both syntactic and discourse/semantic representational constraints in one model. This reflects once more the commitment that linguistic structure is motivated and underpinned by processing considerations. In the domain of conditionals this strategy proves very fruitful, as we shall see, because both sentence-syntactic and discourse-semantic approaches have faced challenges whose resolution has led, contrarily, to a consolidation of the view that the two types of constraints are independent of each other. For example, the structural analyses provided for conditionals following surface-syntactic considerations are usually not directly

compatible with the structures necessary for semantic evaluation and anaphora resolution purposes (see e.g. Boeckx 2003 for a recent demonstration). One case in point is the fact that, whereas in the natural language input the linear order between antecedent and consequent can be variable, discourse/semantic representation requires the antecedent to be processed first so that it provides the context for the processing of the consequent (e.g. according to Stalnaker 1968 the antecedent firstly describes a possible world and the consequent makes an assertion about that world; Strawson 1986 talks about a “ground-consequent” relation; see also Carlson & Hintikka 1979:4, Haiman 1978: 51, Kamp 1981). In order to achieve this result from the possibly incompatible sentence grammar representation further transformations of the output of syntactic processing are required, transformations whose nature is distinct from those employed in the syntactic component (see e.g. the *construal rules* employed in Heim 1982). As a further example consider the fact that, although noun phrases in natural languages like indefinites, definites and universal quantifiers behave syntactically in a unitary way, semantic and discourse-representational approaches postulate distinct representational treatments for them because it is assumed that they exhibit divergent anaphoric/binding behaviour and semantics. Conditionals is one of the environments that have provided striking evidence for such distinct treatments of noun phrases with respect to anaphoric potential. Discourse representational approaches define constraints on anaphora that interact with their analysis of quantificational terms and the structure attributed to conditionals in such a way that certain anaphoric links are precluded or facilitated. The exclusion of some types of anaphoric connection between the terms introduced by, e.g., universal quantifiers as opposed to the terms introduced by indefinites is taken as a primary diagnostic for the transformed structure assigned to conditionals and the divergent treatment of distinct types of quantificational phrases (in particular indefinites being analysed as predicates). This in turn is seen as justification for the necessity of a separate level of discourse processing at which such analyses can be defined.

In this thesis we are going to consider data, some of them novel, which seem to challenge the standard assumptions made in the other frameworks as regards the non-uniform behaviour of definites, indefinites and quantifiers as well as the assumption that conditional antecedents always provide a complete context for the processing of the consequent. The formulation of the DS rules of processing linguistic input employing underspecification in the assignment of content to anaphoric elements and in the construction of semantic representation will be seen to provide a natural basis for expressing the requisite range of anaphoric dependencies in conditional sentences. At the same time, we will be able to sustain an analysis of quantification in which the data considered will be taken care of without the need for a radical reorganisation of the entire framework.

There is a great deal more to say about each of these aspects, as will emerge in due course. But, next we are going to see in more detail the reasons why conditional constructions present such an interesting challenge for the resources made available by a grammar formalism and the semantic considerations that will play a role in assigning them appropriate logical forms.

2. The Relevance Of Conditionals To Linguistic Theory

2.a. Form

2.a.1. Structural characteristics

2.a.1.a. Subordination

In the linguistic literature, structures like the following in (1) below are characterised as *conditional sentences* or *conditionals*.

(1) If John behaves badly, Mary shouts at him.

They are taken to consist of two clauses¹: the *if-clause* (or *antecedent* or *protasis*, or *conditional clause*) and the “main” clause, known as the *consequent* (or *conclusion* or *apodosis*, or *main clause*).

There is a conflict of assumptions in current analyses of conditionals due to the standard dissociation between the grammar and semantic interpretation: Discourse/semantic theories like DRT characterise the apodosis as subordinated to the (clause-initial) protasis for interpretation and anaphoric purposes (see e.g. Kamp & Reyle 1993). On the other hand, syntactic and traditional distributional analyses take the syntactic link between the two clauses in conditional structures as the relation of *adjunction* or *subordination* with the antecedent clause subordinated to the consequent (see e.g. Borsley 2005). In terms of traditional distributional criteria, this is because, unlike main clauses, *if*-clauses are assumed to not be able to occur as stand-alone utterances. In fact this is not the case. Strings with the form of conditional protases can certainly occur as independent *utterances*:

- (2) A: Go away
B: If John wants me to.
- (3) A: Do you want me to read?
B: If you could.
- (4) A: Where is the information desk please?
B: If you could come this way madam

A more accurate assumption is that conditional protases are not normally able to express a complete, truth-evaluable proposition on their own, without the provision of an (implicit or explicit) consequent (the notion of “truth-evaluable proposition” mentioned here is equivalent to a low-level *explicature* in Relevance Theory, see, e.g. Carston 2002). Consequently, syntactic analyses take utterances consisting simply of an antecedent as elliptical or fragments (see e.g. Haegeman 2003: 320, fn. 3). If this assumption, which notably relies on interpretive considerations, is maintained, then there is a real asymmetry

¹ In this thesis we are only concerned with conditionals with finite antecedents although the analysis should extend to non-finite constructions without problems.

between the propositional² content provided by antecedent and consequent. The consequent is (mostly) expressed by a main clause and such clauses are taken to be independently structured. In contrast, the conditional protasis is dependent on the presence of the consequent (although there is no necessary requirement for the provision of an explicit consequent). This is also reflected in the interpretation of tense morphemes in the antecedent and consequent³. It has been observed that the interpretation of tense morphemes in conditional protases depends on the temporal interpretation of the consequent (see e.g. Dudman 1984a,b). For example, present and past tense morphemes in the antecedent can be interpreted as denoting future time:

- (5) If John comes Mary will be upset.
- (6) If John came Mary will be upset.

These considerations provide support to the assumption that syntactically the antecedent is subordinated to the consequent. On the other hand, on semantic grounds, the interpretation of a conditional apodosis is necessarily dependent on the antecedent since the statement made by the proposition expressed by the consequent is not presented as true independently. Therefore, as DRT-style theories predict, the dependency is the other way round: the antecedent subordinates the consequent. This is evidenced by the possible anaphoric connections between terms in the antecedent and the consequent and by word order facts discussed below.

There are two avenues to be explored here to resolve this contradiction: We can either develop a system that postulates a strict separation of the syntactic and semantic representational systems for natural language (see e.g. Culicover & Jackendoff 1997). Or, we can achieve the preservation of a single representational system by attributing the contradictory semantic/syntactic effects to the mechanism responsible for the construction

² For some distinct functions of elliptical antecedent sentences see Dancygier 1998: 142-145.

³ We will not have much to say about tense in this thesis. For a DS analysis of tense see Perrett 2000. For the interpretations of tenses in conditionals see Dancygier 1998, Ch. 2.

of such representations and general processing considerations. Following the spirit of DS, the latter approach will be taken here. We will argue that the connection between the two clauses, protasis and apodosis, has to be captured (a) at the level of logical form where the representations of the content of the two clauses will be linked (bearing in mind that the linking mechanism is asymmetric) and (b) the anaphoric and structural effects associated with the processing of antecedent and consequent will be captured by means of the timing of the application of the processing rules employed. The latter type of explanation crucially relies on the procedural effects triggered by the lexical resources of a particular language. In that respect the particular lexical morpheme *if* introducing a conditional protasis will be employed as an important means of realising the structure required. As other lexicalist frameworks, DS places a heavy burden on the lexicon. However, idiosyncratically, words here are seen as triggers for the execution of whole sequences of actions and structure-building and not just as contributing conceptual content in the semantic representation (this type of view of lexical items is reminiscent of the conceptual/procedural encodings of Relevance Theory, see, e.g. Sperber & Wilson 1995 although incorporated at a different level).

In English, as in many other languages, the conditional clause is distinguished from the main as it is introduced by the complementiser *if* or by special word order:

- (7) If Mary sees John she will warn him.
- (8) Had Mary seen John she would have warned him.

This fact seen from the parsing perspective taken here acquires special significance as an *if*-clause must be taken as providing an encoded indication of its import and affinity to the consequent. Whereas two clauses presented as linked in this way provide a definite indication of the interpretational connection between them, this is not the case when a “conditional meaning” can be derived by what is sometimes called *paratactic conditionals* (Declerck & Reed 2001):

(9) Kiss my dog and you'll get fleas

In these cases the presumed “conditional meaning” is solely the product of inference, as there is no encoded indication that a specific “conditional” relation is intended (cf. Culicover & Jackendoff 1997). As has been pointed out for many cases of coordination discussed in the Relevance Theory literature (see e.g. Carston 1993, Carston & Blakemore 2005) the inference could very well result in any number of semantic relations between the two propositions, e.g. causal, temporal etc. depending on the context of use. For example, consider the following use of the sentence in (9) above:

(10) A: I need to test a new flea treatment for humans. I think I'll test it on myself first. I wonder, how could I get fleas around here?
B: Kiss my dog and you'll get fleas

In the above the conditional interpretation is not necessarily more salient than any of the causal, temporal etc. that can be derived by *enrichment*⁴ from a conjunctive statement. Therefore there is no need to assign a special “conditional” meaning to the construction or the lexical item “and”. On the other hand, since DS provides a modelling of the interface between linguistic rule-governed and inferentially derived meanings, its adoption of Relevance Theory assumptions about inference can explain how in these instances the variable contribution of distinct processes can derive interpretations similar to those achieved by the processing of encoded conditional interpretations. As the two systems are taken to manipulate common representations and to interact on-line, the fact that two distinct formulations can receive a single interpretation does not have to mean that there are *linguistically* specified common characteristics. For this reason the category of *paratactic conditionals*, although enlightening from the point of view of how inferential processes enrich content, will not be taken as part of the concerns of this thesis which seeks to define how the specific *linguistic* input provided by conditionals constrains the resulting interpretations.

⁴ For the process of *enrichment* in Relevance Theory see e.g. Carston (2002).

2.a.2. Word order

If, as DS maintains, linguistic information is progressively processed and integrated through the construction by the hearer of a structured logical form then the presentation of this information in a left-to-right fashion provides another dimension which can be exploited as a resource for the derivation of inferential effects. However, for such effects to be accounted for, firstly, the grammar formalism has to define how the enforced mono-dimensional mode of presentation of a structured message results in, perhaps arbitrary, encoded constraints which confer systematicity on the interpretation of linguistic signals (this is one view of the problem of *compositionality* see Cann et al 2005, Ch. 1). In this respect the general or language-particular word order constraints can be both a means for conveying additional information (e.g. focus or topic effects) but also a restriction on how a message can be articulated in time. DS caters for this latter property of natural language signals by providing a general system of rules which specifies the permissible actions that can be taken by the parser according to the particular structural context and accumulated information at each particular point in the parsing task. Linguistic restrictions like word order and patterns of extraction and copying⁵ are characterised by DS solely by means of this definition of admissible continuations. As one of the concerns of this thesis is to incorporate into DS the particular restrictions imposed by the processing of conditionals we will now examine the word order patterns that characterise strings including *if*-clauses. Such patterns primarily include the positioning of the *if*-clause with respect to the consequent but also the dislocation phenomena that affect both clauses.

The *if*-clause, like other adverbials, can appear in different positions without obvious truth-conditional effects:

- (11) If John shouts, Mary gets upset.
- (12) Mary gets upset if John shouts.

⁵ The terms “extraction”, “copying”, “dislocation”, “deletion” etc. are only used here because of their usefulness in making reference to established grammatical phenomena.

- | | |
|---|----------------------|
| (13) Mary, if John shouts, gets upset | |
| (14) If Sue raises, Bill will call ⁶ . | from Abbot (2005: 9) |
| (15) Bill will call, if Sue raises. | (ibid) |
| (16) Bill, if Sue raises, will call. | (ibid) |
| (17) Bill will, if Sue raises, call. | (ibid) |

A DS analysis of *if*-clauses needs to provide the resources for processing them at different positions. As usual in DS this will be achieved by a combination of lexical and general processing rules.

Another phenomenon that has to be modelled is the fact that there is no strict adjacency requirement between antecedent and consequent. The consequent corresponding to a clause-initial antecedent might be embedded as can be seen in the cases below:

(18) [If John leaves] Mary believes that Bill will stay =

a. Mary believes that if John leaves Bill will stay

or

b. If John leaves then Mary believes that Bill will stay.

(19) If you leave I think that I will leave =

a. [If you leave] (then/in that case) I think I will leave

or

b. I think that [if you leave] (then) I will leave

(20) If the dinner had been ready Mary believes that John would not have complained

a. [If the dinner had been ready] (then/in that case) Mary believes that John wouldn't have complained

or

b. Mary believes that [if the dinner had been ready] (then/in that case) John would not have complained

However, the distance between antecedent and consequent is not arbitrary. Their separation respects what in the linguistic literature are sometimes called *island restrictions*. This means that, for example, the antecedent of a

⁶ These examples should probably interpreted in the context of the game of Bridge (as pointed out by Ronnie Cann).

conditional cannot be construed as originating inside a relative clause or the complement of an deverbal noun (*Complex NP-constraint*, Ross 1967):

- (21) Mary called the man who will be hired if John leaves. \Rightarrow
- (22) *If John leaves Mary called the man who will be hired.
- (23) Mary believed the claim that Bill will leave if John stays. \Rightarrow
- (24) *If John stays Mary believed the claim that Bill will leave.

This seems to imply that antecedent and consequent stand in some kind of local relation that has to be expressed by the formalism.

Another aspect of the properties of such structures that has to be explained is the fact that extraction is not allowed from inside an *if*-clause, i.e., *if*-clauses, like relative clauses, are themselves *islands* (cf. (25)-(26)):

- (25) John saw the man who shot Mary \Rightarrow
- (26) *Who did John see the man who shot?
- (27) John will fire Mary [if she calls John]. \Rightarrow
- (28) *Who will John fire Mary if she calls _ ?
- (29) [If John sees Mary] he will kiss her. \Rightarrow
- (30) *Who [if John sees _] will he kiss her?

On the other hand, the relation between antecedent and consequent is unlike that of two conjuncts related by *and/or/but* in that the type of relation between them does not allow for several phenomena that characterise coordinated clauses. First of all, *Right Node Raising* is precluded between antecedent and consequent (as indeed is also the case with relative clause structures):

- (31) John will support and Mary will try to promote the manager of their department
- (32) *If John supports _ Mary will try to promote the manager of their department
- (33) *[Mary will support _] [if John tries to promote _] *the manager of their department*
- (34) Mary will support John Petropapadopoulos, who Bill met yesterday \Rightarrow
- (35) *[Mary will support _] [who Bill saw _] *John Petropapadopoulos*.

Two clauses related by the conjunction *and* can be made to share a common subject (*Conjunction Reduction*). This structure is not allowed for *if*-clauses and relatives alike :

- (36) John [bought the newspaper] and [sold the milk]
- (37) *John [bought the newspaper] if [sold the milk]
- (38) *If John [sold the milk] [bought the newspaper]

(39) *Mary [will support John], who [met yesterday]

Another difference that points to distinct analyses for conjunctions on the one hand and *if*-clauses and relatives on the other is the phenomenon of *Gapping*. When two clauses are coordinated the verb of the second clause can be elided if it is identical to the one in the first one:

(40) John *will buy* the newspaper and [Mary _ the milk]

There is no corresponding construction for *if*-clauses (neither with relatives):

(41) *John *will buy* the newspaper if Mary _ the milk

(42) *John saw Bill who _ Mary

On the other hand, coordinated clauses allow for the phenomenon of *Across-the-Board* extraction:

(43) The man who [John dislikes _] and [Mary loves _] came to see me yesterday

(44) Who [did John dislike _] and [Mary love _]?

If-clauses do not generally permit extraction:

(45) Who did John dislike _ if Mary saw _ ?

The parallel properties of *if*-clauses and nominal relatives, which contrast with the properties of coordinate structures, have led several researchers to the assumption, which will be adopted here, that, in some sense to be made precise, *if*-clauses fall within the same class of structures as relative clauses in the same way that *when*-clauses and *where*-clauses can be taken as relatives over implicit time or location specifications (see e.g. Geis 1985, Bhatt & Pancheva 2001). Nevertheless there is one difference between these clauses and *if*-clauses (pointed out by Geis 1985). Consider the following:

(46) John left when Mary claimed that Bill left

(46) is ambiguous between the following two interpretations:

(47) John left at the time at which, according to Mary, Bill left

(48) John left at the time at which Mary made the following claim: "Bill left"

Unlike *when*-clauses *if*-clauses are not ambiguous in that respect:

(49) John left if Mary claimed that Bill left.

(50) In any case that is such that Mary made the claim: "Bill left", John left (in that case)

(51) # John left in any one of the circumstances that Bill left according to Mary's claims

When *if*-clauses are analysed as the same type of construction as nominal relatives and *when*-clauses this pattern of idiosyncratic behaviour regarding the strict locality requirement internal to the antecedent is awkward for frameworks that employ uniform processes of movement, or movement-like operations. There can be no non-ad hoc restrictions of general mechanisms in explaining this difference in extractability. In contrast DS (as well as other lexicalist frameworks) can deal comfortably with idiosyncrasies of this type since by definition each word is individually associated with a particular set of procedural actions which, it is plausible, may deviate from their common historical patterns under functional or pragmatic pressures.

The discussion about the similarity between nominal relatives and conditionals raises the issue of what kind of term an *if*-clause is a relative of. This brings us to the topic of what type of semantic representation is constructed out of the processing of a conditional sentence. Along with other researchers, we will assume here that *if*-clauses are relatives over a term inducing universal quantification over a domain of contextually specified events or situations. But before presenting this proposal we will review alternative possible semantic analyses and the reason why we will not adopt them in the precise form that they have been defined. This is essential in this context because, unlike other frameworks where syntactic issues are very generally taken as independent of and prior to semantics, in DS, the syntax is nothing more than the progressive construction of some logical representation. Therefore syntactic and semantic issues are fundamentally inter-dependent, as we shall see throughout the thesis.

2.b. Semantics

The literature on conditionals has to be quite the most dauntingly large literature there is, as the semantics of this construction has attracted a great deal of attention from linguists, philosophers, and logicians over a very large span of time. As Smith & Smith (1988) put it:

“Conditionals involve virtually every problem – logical or linguistic, descriptive or theoretical – that has ever been raised” (1988: 350).

We cannot therefore in principle hope to cover all the issues here. What will be attempted instead is an outline sufficient for current purposes only, in particular the purpose of probing the interface between semantic and structural properties of natural language. We start with the minimal truth-functional analysis and continue with attempts to preserve it in the face of claims of its inadequacy.

2.b.1. *The truth-functional analysis*

A first approximation to the semantics of natural language conditionals is that achieved by translation in the language of classical logic. Such translations involve two propositions conjoined by the \supset (or \rightarrow) symbol which is interpreted as *material implication*. Under this view, the truth conditions associated with the construction consisting of an *if*-clause and a consequent can be given by the truth-table interpretations of the truth-functional connective \supset which gives either True or False according to the truth values of the conjoined propositions. The truth value False for the whole construction results only when the antecedent is assigned True and the consequent False. In all other cases the conditional sentence must be taken as True.

It was observed early on that when applied to natural language interpretations this analysis is associated with a lot of dilemmas, cumulatively referred to as *the paradoxes of the material implication* (see Gazdar 1979, Gibbard 1981). As far as linguistic issues are concerned, one serious problem seems to be how to derive in a systematic way the intuitive

interpretations associated with conditionals. The strictest version of the *Compositionality Principle*, requires that the meaning of a construction is solely dependent on the meanings of its component parts:

It is *only* the meaning of the parts and their syntactic mode of combination that matters.
(Hintikka 1980, cited in Partee 1984b/2004: 162)

For semantic theories which more or less follow this principle and where truth conditions for natural language sentences have to be given in abstraction of use in context the material implication analysis for conditionals creates insurmountable problems as the truth conditions given do not adequately correspond to speakers' intuitions. Firstly, it has been claimed that natural language conditionals do not have a use where the fact that the antecedent is false or the consequent true is sufficient grounds for asserting the truth of the whole conditional:

- (52) [_A The war in Iraq has not ended]
 [_{¬A} If the war in Iraq has ended] then [_B there was never any conflict in Iraq].
- (53) $\neg A$ therefore $A \rightarrow B$
- (54) [_B George Bush is the President]
 If [_A George Bush did not win the elections] then [_B he is the President]
- (55) B therefore $A \rightarrow B$

Moreover, the standard logical equivalences between formulas that hold among formulas in classical logic do not seem to be valid for natural language sentences involving conditional structures. Faithful translation of natural language connectives as those of classical logic give truth-conditionally incorrect or at least weak results in these cases. For instance, in propositional logic, (57) implies (59). However, their presumed natural language equivalents do not seem to allow the inference from (56) to (58):

- (56) If (both) switch A and switch B are on, then the engine will run
- (57) $(A \wedge B) \rightarrow C$
- (58) If switch A is on, the engine will run, or, if switch B is on, the engine will run.
- (59) $(A \rightarrow C) \vee (B \rightarrow C)$

The material implication analysis for indicative conditionals can be defended against those failures on the grounds that interpretation of language involves much more than simply considering truth conditions (see Grice 1989,

Smith 1983, Smith & Smith 1988). Therefore, since the material implication analysis is the minimum required for allowing properties of the human inferential system to be discerned in language structure and since it can be shown that there are uses of conditionals which necessitate the material implication interpretation, this interpretation should be seen some kind of initial encoded meaning which can be pragmatically enriched to derive the interpretations required for other uses. For example, it seems that the only way to explain the uses of sentences like (60) below for cases where a speaker wants to assert the falsity of the antecedent is by means of the material implication analysis: If the whole conditional is presented as true and the consequent is manifestly false then the antecedent must be presented as false as well, which can only be derived by a truth-functional analysis of the meaning of the natural language conditional (example from Suber 1997):

(60) If Congress passes serious campaign finance reform, then I'm a monkey's uncle!

For cases where the licensed inferences do not seem to be able to go through as in (56) one can then say that if a speaker intended the stronger interpretation (where both the switches have to be on for the engine to work) then it must be made clear in order to avoid misleading the audience (i.e. the use of *both* is not dispensable in this context). Another explanation could be that in actual language use a statement presented as the coordination of two propositions has to be taken as a single inferential unit, at least initially, so that its component parts cannot be separated without loss of inferential effects whatever the truth conditions (see e.g. Blakemore 1987, Smith 1983).

However, even if such defences of the material implication are taken into account there remain questions. For example, in analysing what the explicit content of a statement is, it is standard to consider whether some element in dispute falls under the scope of logical operators (see, e.g. Carston 2002: 191-197). Now consider this test applied to a conditional statement under the scope of negation:

(61) It is not the case that if the peace treaty is signed war will be avoided. Therefore the peace treaty will be signed. (from Smith 1983: 10)

Under an analysis of the conditional as material implication the argument is logically valid:

(62) $\neg(P \rightarrow Q) \leftrightarrow P \wedge \neg Q$ therefore

(63) $[\neg(P \rightarrow Q)] \rightarrow P$

However we would not want to say that a statement involving the negation of a conditional would ever be able to communicate the content in the second part of the equivalence in (62). Whatever means of transforming the logical form of such sentences might be sought (see, e.g. Grice 1981: 196-197, Smith 1983: 13) the fact remains that a linguistic analysis of the content of natural language connectives has to provide a plausible minimal basis so that pragmatic enrichment can provide an appropriate content in each particular context (and, according to standard assumptions, enriched content that can fall within the scope of logical operators like negation has to be part of the explicitly communicated message conveyed by such utterances). Now if we can achieve such a minimal logical form without resorting to (non-monotonic) “re-bracketing devices” (Grice 1981) or computations of the relevance of alternative logical forms (Smith 1983) then the fact that such arguments are not even considered as potentially valid by language users can be accounted for (otherwise, what excludes the minimum truth-functional interpretation from being able to be relevant at least in some such contexts?).

A further consideration is that it has been argued that when an analysis for the semantics of counterfactual conditionals is sought the material implication analysis cannot be adequate. The logic that utilises the material implication symbol and its semantics is appropriate for the uncovering of what does and does not follow from facts that have been established as true. Although it does that in the most appropriate and efficient way, it does not take into account the human need to envisage and reason about situations where a false proposition is assumed temporarily and relevant implications in accordance with the actual circumstances are explored. Under a naïve

material implication analysis of natural language conditionals, counterfactuals are predicted to be always true since the antecedent is not taken to be true in the actual world (this is the main reason for assuming that counterfactuals cannot be truth-functional, see, e.g. Quine 1952). For a grammatical analysis this means that, unless one wants to maintain radically distinct semantical representations for indicative and counterfactual conditionals (see e.g. Adams 1970, Lewis 1973), a general analysis of the meaning of *if* must be sought that, while maintaining the advantages of the material implication analysis, also allows for both types of cases, factual and counterfactual reasoning and argumentation.

In fact, as Carston (2002: 254-257) points out, there is no a priori reason to suppose that a cognitive-realistic analysis of the “meaning” of any natural language connective should correspond directly with its analogue in any logical calculus given that the latter has been devised with the purpose of a direct referential semantics whereas natural language is interpreted through the construction of intermediate representations in some language of thought (*LOT*, see, e.g., Fodor 1975). And, concerning the conceptual representations that conditional sentences have to be assigned. Stalnaker (1992) observes:

“One can, of course, define a truth-functional connective that has some of the properties of the conditional -the so-called material conditional - but it neither gives an intuitively plausible account of the logic and semantics of the conditional sentences of natural language that we find ourselves using, nor does it have the promise to do the conceptual work that we would like to use conditionals to do” (1990: 316).

From this point of view, as far as representational questions are concerned, it seems that there is no reason to assume that natural language conditional sentences should map directly to *LOT* formulas with the syntactic format that propositional or predicate logic formulas bearing the \supset connective display (even if we take propositional or predicate logic as the model for *LOT* inference) and therefore this type of semantics might not be directly recoverable from natural language conditionals. Striving to establish such a direct mapping can necessitate a lot of redundant transformational power for the linguistic system as, for example, in the analysis of natural language quantification where a separate syntactic level has to be postulated (*LF*) so

that the linguistic representations that are input to the semantic component resemble syntactically predicate logic formulas (see e.g. May 1977). On the other hand, if we eschew intermediate *linguistic* levels of representation we are left with the problem of how to maintain some notion of compositionality for the linguistic system since, beyond cases of underspecification and analyses of linguistic elements as contributing only procedural type of information, the simplest linguistic analysis will maintain that at least some compositional-semantic properties of LOT are discernible in natural language structure (this assumption provides a basis for explaining the systematic contribution of the linguistic apparatus to the process of constructing LOT representations). The formal properties of natural language conditional sentences described above, especially the commonalities between *if* and *when/where* and relative clauses do not receive adequate motivation under a direct mapping to a formula with the syntactic format that involves the predicate logic material implication symbol since the compositional interpretation of these formulae simply requires two propositions with equal status. However, as we saw earlier and will see again in the following chapters, the *if*-clause seems to have status distinct from the main clause. This would not be an expected effect if the lexical item *if* just mapped to a compositionally interpreted formula involving simply a truth-functional connective. For all these reasons in seeking to define the appropriate LOT representation to be assigned as the minimal content derived from natural language conditionals we turn now to the significance of the modal analyses of counterfactual/subjunctive⁷ and indicative conditionals. This is the purpose of the following section.

2.b.2. *The modal analysis*

Intuitively, the material implication translation of counterfactual conditionals seems to give unacceptable results, especially when these conditionals are taken to be part of the set of beliefs an individual might hold or present to an audience. For example, the following two sentences can both express

⁷ We will not discuss here the presumed difference between subjunctive and counterfactual conditionals. For the use of the terms adopted here see Barwise (1986: 22-23).

propositions that can be taken as true by an individual without having that individual judged as unreasonable or inconsistent (cf. Gibbard 1981):

(64) If Labour had lost the elections in 1997 Michael Howard would be Prime Minister now.

(65) $P \rightarrow Q$

(66) If Labour had lost the elections in 1997 Michael Howard would not be Prime Minister now.

(67) $P \rightarrow \neg Q$

The logical forms of these two sentences seem inconsistent with each other unless, under a material implication analysis, it is assumed that they are trivially true because of the falsity of the antecedent. However, such sentences seem to be judged as true or false according to the considered circumstances. (cf. the debate about the *Law of Conditional Excluded Middle*, e.g. Lewis 1973/1986, Stalnaker 1981b⁸). The difficulty seems to be that individuals can hold propositions as true not in isolation, or according to what the objective facts are, but instead as part of distinguished sets of other assumed or known propositions. The system of classical logic has been designed with the purpose of modelling implication relations between facts that are taken to reflect some assumed reality, a single set of circumstances, the actual world (this assumption underlies the suitability of material implication in mathematical discourse, the domain of eternal truths, although see Barwise 1986 for doubt regarding this domain too). Natural language subjunctive conditionals are not amenable to a direct, naïve translation into classical logic because, intuitively, when such conditionals are either stated or considered we seem to make explicit reference to alternative (possible) realities where distinct facts might be taken as true. Such alternative realities are computed on the basis of what is taken to be the actual world and truth of the conditional is then judged according to these alternative states of reality, hence its relevance for human reasoning and communication.

A logical system that can be interpreted as referring to alternative states is that of Modal Logic. Translations in Modal Logic can be utilised to model

⁸ see also von Fintel (1999).

the semantics of modal or temporal expressions in natural languages. Since it is felt that the truth of a conditional involves envisaging alternative states of the world, the semantic representation of such sentences would seem to also require translation in the language of Modal Logic. Such translations can be given by introducing a necessity operator taking scope over the material implication symbol (the *strict conditional* analysis):

(68) $\Box (P \rightarrow Q)$

Under the possible worlds semantics for modal logics the interpretation of operators like \Box or \Diamond is provided by means of universal or existential quantification over possible worlds respectively. A possible world can be taken as “the ontological analogue of a stock of hypothetical beliefs” (Stalnaker 1975a: 169). Therefore the statement of truth conditions for (68) above will be as follows:

(69) for every possible world w , if P holds in w then Q holds in w

In order to model alternative conceptions of necessity or possibility (e.g. epistemic, deontic, metaphysical etc.) an accessibility relation R among worlds can be introduced in the models so that quantification is restricted to the appropriate worlds. The properties of such a relation will characterise the type of necessity/possibility involved. For a logical form like the one in (68) the truth conditions for an evaluation world w^* then would be as follows:

(70) for every possible world w , if w is R -accessible from w^* and P holds in w then Q holds in w

Since the conceptual apparatus utilised in the semantics of modal languages is in any case necessary in the analysis of temporal and modal expressions of natural language it would seem that its extension to the semantics of conditionals is adequately motivated. However, in the formal semantics/philosophical tradition it has been felt that a simple-minded *strict conditional* semantics is not any more adequate than the material conditional because of problems having to do with inference patterns predicted to be valid from a logical point of view but unsupported by counterfactuals as used

in natural language or reasoning (e.g. failure of *Transitivity*, *Contraposition* and *Strengthening of the Antecedent*, see Stalnaker 1968, Lewis 1973/1986 also below). Therefore, it is claimed, the truth conditions must be further specified and encoded as part of the semantic content of natural language conditionals. Two approaches to the problem are dominant: that of Stalnaker (1968) and Lewis (1973/1986). Stalnaker adds to the standard model structure a *selection function* f which selects for each antecedent of a conditional a particular possible world which “differs minimally” from the evaluation world and in which the antecedent is true. If the consequent is also true in this world then the whole conditional is true in the evaluation world. The problem identified above with (64), (66) can now be resolved if we assume that when giving the semantics of conditional statements/beliefs we take into account not the totality of all alternative possibilities but instead, a distinguished “most similar” world. Lewis (ibid: 77-83) criticises this analysis in that it presupposes that a single most similar world will always be available. Lewis argues that this is not the case and proposes instead that alternative possible worlds are to be taken as organised in a system of *spheres* around the world of evaluation in such a way that some of them are *closer* or more *similar* to it than others. He adds the connective $\Box \rightarrow$ to the language to serve as the sign translating “counterfactual”/subjunctive conditionals (the *variably strict conditional* analysis). Then one can say that when the situation arises where both $P \Box \rightarrow Q$ and $P \Box \rightarrow \neg Q$ seem to be able to be true then the set of worlds where $P \Box \rightarrow Q$ is true must be distinct from the set of worlds where $P \Box \rightarrow \neg Q$ is true. The analysis of conditionals as *variably strict* explains the non-monotonic properties of conditional reasoning, e.g., the well-known fact that ‘strengthening’ the antecedent of a true conditional does not preserve its truth:

- (71) If Otto had come, it would have been a lively party; but if both Otto and Anna had come it would have been a dreary party; but if Waldo had come as well, it would have been lively; but...
- (72) # If I strike this match, it will light. Therefore if I dip this match into water and strike it, it will light
- (73) # If John came, Mary would be happy. Therefore, if John came and he was drunk, Mary would be happy.

(74) # If kangaroos had no tails they would topple over. Therefore if kangaroos had no tails and used crutches they would topple over.

Since the set of worlds is organised into a system of concentric *spheres* according to their remoteness from the actual world, failure of strengthening the antecedent is accounted for because, when a conditional with a stronger antecedent is considered, its semantic evaluation is accomplished at a different sphere, perhaps more remote, than the original one. Similar explanations are given for the other failures of counterfactual reasoning. One should note that Lewis' analysis does not do away completely with some of the significance of the material implication of classical logic since, e.g., when no world is accessible then the truth-conditions of, e.g., $P \Box \rightarrow Q$ coincides with that of material implication.

Whatever the abstract logic of counterfactual reasoning may be the question that arises for natural language conditionals is whether selection of a restricted set of worlds is a semantic or pragmatic issue. If we seek a representation on which to base an analysis of the encoded meaning of natural language conditional sentences, the truth conditions in (70) above seem to provide the minimum required. As has been pointed out by Kamp (1988) there is an intimate connection between the concepts of universal quantification and implication reflected in Frege's choice to analyse universally quantified sentences by means of the implication symbol⁹. We can then safely assume that the encoded meaning of natural language conditionals involves mapping to a conceptual representation that (at least) includes some kind of universal operator¹⁰ (universal quantification is argued for in von Fintel (2001, 1999, 1997); Schlenker 2004 takes conditionals as

⁹ This parallel is somewhat obscured in a generalised quantifier analysis of universal quantification.

¹⁰ The desirable truth of examples like (60) above might be accounted for if we treat them as cases of universal quantification where no element in the domain of quantification satisfies the restrictor and therefore the implication is vacuously true, but conversationally informative (cf. Lewis 1973/1986: 16). This will involve abductive reasoning on the part of the hearer but this is as expected in a pragmatic account. This consideration seems to contradict the assumption of a (hard-wired) "existential presupposition" posited in the analysis of conditionals in e.g. von Fintel (2001), von Fintel & Iatridou (2002: 9). The same goes for the "Antecedent Requirement" in Lycan (2001: 28).

plural definite descriptions of worlds but since he assumes an analysis of definites that involves maximality, the general spirit of his analysis is compatible with the present point of view¹¹). Given that in the present approach underspecification of linguistic content with respect to interpretation in context is taken for granted, this semantics seems suitable also because it provides the appropriate locus of interaction with the context of utterance in that the exact specification of the accessibility relation can be taken as underspecified. Arguably an adequate pragmatic theory should be able to provide the basis for overcoming the failures noted above by further specifying the properties of the accessibility relation in each particular context. It seems obvious that, as predicted under relevance theoretic assumptions, such failures must be attributed to the distinct selected contexts for the processing of the antecedents at each stage of the arguments (see e.g. Papafragou (1996, 2000) for an analysis of how distinct contexts are selected in the domain of modality in terms of a relevance-theoretic framework combined with Kratzer's 1981 semantics for modals; see also von Stechow 2001 and references cited there for similar views and explication of the pragmatic, in von Stechow's view, semantic, task¹²). This approach is corroborated by the fact that, as Johnson-Laird & Byrne (2002: 659) point out, inference failures like those observed with counterfactuals above can also result with disjunctions:

(75) You put the ice-cream in the fridge or it melts. Therefore, you put the ice-cream in the fridge or the oven or it melts.

We can then take the Stalnaker/Lewis analysis not as explicating the semantic content of natural language conditionals but rather as an abstract description of (part of) the task to be accomplished by a pragmatic enrichment of a context dependent component in their content (see also Smith & Smith

¹¹ However, in DS definites are analysed as anaphoric, therefore, Schlenker's particular implementation cannot be adopted here, see below.

¹² Regarding the irreversible shrinking of the "modal horizon" postulated by von Stechow, intuitions are not at all clear. See Lycan (2001: 30).

1988: 329¹³; from this perspective, von Fintel's analysis (e.g. 2001) also provides an abstract definition of some aspects of the pragmatic task involved). In that respect, the encoded semantic content of a natural language conditional could be left as underspecified in the same way that the domain quantified over is underdetermined in the usual cases of universal quantification over individuals¹⁴: since the truth conditions involve universal quantification it is a factor of the circumstances of evaluation in each particular context to determine what the domain of quantification should be. The intuitive idea that in many cases what is relevant to the assessment of a conditional is some kind of *connection* between the antecedent and consequent can only be cashed out in pragmatic terms. Reliance on an adequate pragmatic theory will allow us to leave the truth conditions as in (70)¹⁵. This type of analysis is supposedly refuted in Lewis (1973/1986: 13) who claims that the failure of Strengthening the Antecedent in e.g. (72) cannot be attributed to the changing context since the example is deliberately given in a single run-on sentence. As also pointed out by Schlenker (2004) this is not a valid assumption (see also von Fintel 2001). Current pragmatic theories certainly do not assume that selection of context is a static affair within sentence boundaries (see e.g. Carston 2002). This stance is also reinforced by the following example involving domain restriction for universal quantifiers over individuals cited by Schlenker (2004, attributed to D. Westerstahl):

¹³ The DS analysis we are going to propose later which involves the contents of antecedent and consequent as being related by means of the LINK relation provides the syntactic basis for implementing the intuition expressed in Smith (1983: 15-19) regarding how to resolve the issue of failure of Strengthening the Antecedent: structures related by means of the LINK relation are presented by a speaker as a single "inferential unit" and therefore must be processed as such for relevance (conjoined clauses as well as conditionals involve such LINK structures).

¹⁴ For different ways of expressing this intuition see: Stanley & Szabo (2000), Bach (2000), Carston (2000).

¹⁵ A question that arises in this type of analysis is whether the process involved in the derivation of such interpretations can be characterised as "free enrichment" or "saturation" (see, e.g. Carston 2002). As we will see later, we follow Papafragou (2000) here in assuming that such domain restrictions are cases of saturation.

(76) [Situation: A committee must select some applicants. Some of the applicants are Italian, and there are also Italians on the committee, though of course they are not the same.]
Every Italian voted for *every Italian*.

We conclude that Lewis' objection does not hold. Schlenker (2004) mentions another objection to an analysis of *if*-clauses involving universal quantification, as opposed to an analysis in terms of plural definite descriptions, which he finds decisive. An analysis in terms of universal quantification can only work if we assume that the domain quantified over is contextually restricted (in order to explain the failures of reasoning patterns mentioned above). However, he presents the following example as showing that, although the domain of a universal quantifier can be adjusted contextually, it cannot be made to achieve the same effect that use of a definite description can achieve. In the following, it is claimed, the definite description is able to pick up a *salient* subset of the domain whereas the universal quantifier is unable to do so, hence the infelicity of (77)b:

(77) [There are ten girls and ten boys in the class. *Three girls* raise their hands. Talking to the teacher, I say:]
 a. Wait, *the girls* have a question!
 b.# Wait, *every girl* has a question!

This argument is not decisive under the analysis of definite descriptions and universal quantifiers assumed here. In DS, definite descriptions, like pronouns, are analysed as anaphoric in the sense that they contribute a radically underspecified piece of information in the representation, which has to be substituted by a term available in the context in order for the parse to be successful. On the other hand, universal quantifiers introduce a fresh variable and the appropriate quantificational binder which, being initially incomplete, has to be transformed to a complete term incorporating its scope dependencies at the end of the parse. In this respect, if there is a particularly salient (sub-)set in the utterance situation it is predicted that a speaker is more likely to use a definite description whose content by assumption is directly dependent on the context rather than the more cognitively expensive operation of introducing a fresh variable and then relying on a contextual restriction of the domain of quantification (from this point of view, this effect is

similar to using the speaker's name instead of an indexical like "I" although both lexical items could be taken to map to the same propositional constituent in a particular context). Moreover, use of a plural, anaphoric definite description is also expected to be intended to include *all* the distinguished (most salient) members of the set satisfying the description, otherwise a numeral would have been used. Notice, also, that it is not impossible for (contextually restricted) universally quantifying expressions to be interchangeable with definite descriptions in similar contexts in case slightly different effects are required. In the situation described above, after the three girls have asked their question the speaker can say to the hearer:

(78) Astonishing! Every girl raised a point that even I could not answer

In this case the universal quantifier does not have to be taken as ranging over the set of the ten girls (as opposed to the relevant subset of the three girls who asked questions). Alternatively the speaker could have said:

(79) The girls raised points that even I could not answer.

The conclusion seems to be that when an appropriate theory of definiteness and quantification is supplied, Schlenker's example does not provide a valid objection to an analysis of conditionals as involving universal quantification. The domain of a contextually restricted universal quantifier can be taken to be a salient set of objects if this is relevant in the circumstances. Nevertheless, *saliency*, as defined by Schlenker, is not necessarily the notion required for defining the domain of quantification for conditionals¹⁶: Firstly, under a relevance-theoretic conception of dynamic context selection, a notion of pre-defined saliency ordering does not provide a cognitively realistic picture. Moreover, especially for counterfactual/subjunctive conditionals, there is no reason to assume that there is anaphoricity involved in the selection of the restrictor as Schlenker's analysis combined with an anaphoric theory of

¹⁶ As Papafragou (2000) argues for the domain of modality, the information needed for constructing appropriate restrictors is computed on the basis of cognitive considerations of economy and plausibility guided by the principle of relevance; from this point of view *saliency*, as defined by Schlenker (2004), is not necessarily co-extensive with such notions.

definiteness would necessitate¹⁷. In further support of his thesis, Schlenker finds a contrast between (80) and (81) below. According to him, (80) is contradictory whereas (81) is not. He takes this as indicating that whereas *necessarily* induces universal quantification, and therefore monotonic behaviour is expected, the *if*-clause does not:

(80) If the United States threw its weapons into the sea, there would be war. However, if the United States and all other nuclear powers threw their weapons into the sea, there would be peace.

(81) # Necessarily, if the United States threw its weapons into the sea, there would be war. However (necessarily) if the United States and all other nuclear powers threw their weapons into the sea, there would be peace.

However, as he admits, intuitions about such examples are not at all strong. The mild contrast that might be taken to exist above can be attributed to the fact that the adverb *necessarily* is used in (81) which might induce a distinct type of domain of quantification of its own. Moreover, the fact that two universally quantifying expressions are used instead of one certainly contributes to the contrast. This is certainly expected from a relevance-theoretic point of view as the effect of emphasising the fact that *all* possibilities must be taken into account cannot be taken to have no impact on interpretation. If anything, the contrast shows that, as argued here, *if*-clauses cannot be taken to simply restrict quantificational expressions but rather as introducing their own quantificational force (see also von Stechow & Iatridou 2002). In any case (necessarily unnatural) examples can be constructed where the use of *necessarily* does not exclude non-monotonic behaviour (removing the emphatic effect of “adverb preposing” for *necessarily* would also contribute to the acceptability of the argument below):

(82) Necessarily, if the United States went to war with Iran, then Britain would go to war too. However if the United States went to war with Iran and the British Muslim Party had won the election, Britain (necessarily), would not go to war.

We conclude that the simplified encoded semantics for conditionals in (70), involving universal quantification, is adequate if supplemented with an

¹⁷ An added problem with Schlenker's account, as he also points out, is that it is difficult to find cases of collective predication over a set of worlds.

appropriate pragmatic theory defining the accessibility relation in terms similar to that in Papafragou 2000 (for the interaction between encoded meaning and pragmatics in conditionals see also Johnson-Laird & Byrne 2002).

However, the problem that remains now is to define the appropriate entities that should be quantified over in the posited representations of the propositions expressed by conditionals. Possible worlds cannot be taken for granted here because the conception of alternative *possible worlds* as psychologically real entities that play a role in the computation of meaning has come under criticism (Partee 1979, Smith 1983). Entire, complete possible worlds, which by definition provide a truth value for each proposition (i.e. a God's eye view of possibilities), cannot be the actual objects considered in human reasoning or semantic evaluation of natural language statements. As in most cases non-denumerably infinite sets of possible worlds are needed in order to explicate the abstract semantics assigned to modalised sentences, doubts have been expressed as to whether these models can be assumed to be even compatible with human language users' abilities. Stalnaker and other possible world semanticists seem to make a kind of competence-performance distinction as far as the employment of possible worlds is concerned: worlds are not employed in order to explicate the mechanisms used to represent information but rather as the means of describing in an idealised way the information that has to be represented. However, possible world approaches have been criticised even if confined to this abstract point of view of information specification. In the domain of conditionals, Barwise (1986) has argued that employment of a possible world framework causes difficulties with the semantics of conditional statements that concern propositions that must be either true or false in every possible world (such as mathematical truths, see Barwise *ibid*: 25-27¹⁸). The truth conditions of such conditional statements, even under the Lewis/Stalnaker approach, will exhibit exactly the absurdities that we sought to resolve by

¹⁸ Similar well-known problems arise of course in the domain of propositional attitudes, see e.g. Fox & Lappin (2005).

rejecting the material implication analysis, only this time transferred to the domain of alternative worlds. This is because the relevance of the content of the antecedent to that of the consequent cannot be captured by such a “blunt instrument” as a possible world semantics; for this reason the idealised truth conditions are not adequate even for mathematical reasoning. Without adopting Barwise’s particular solution to the problem (which has a characteristic anti-representationalist flavour), we must consider seriously the upshot of his arguments which is that, even in mathematical uses, conditionals are radically context-dependent and that possible world accounts are not fine-grained enough approaches to capture the relevant distinctions. Contrary to Barwise’s conclusion though, as far as the semantics of conditionals is concerned, there is no necessity to *encode* that there must be a “connection” involved between the subject matter of the antecedent and that of the consequent: as Stalnaker (1975a: 167-168) shows, there are cases where if you firmly believe the truth of the consequent, you are prepared to assert the truth of the entire conditional even if you believe that the truth or falsity of the antecedent makes no difference and has not relevance to it. Similar arguments are also presented in Johnson-Laird & Byrne (2002: 651) regarding *relevance* conditionals¹⁹, deontic conditionals, etc. What this shows is that although Barwise is right to point out that a possible world semantics does not discriminate adequately the relevant circumstances and that a “connection” must sometimes be inferred between the two propositions in a conditional structure, the latter is not a matter for semantic encoding but rather for pragmatic processing²⁰. If the relevance of the subject matter in antecedent to that in the consequent can be captured by invoking an appropriate pragmatic theory then Barwise’s arguments can be taken as showing that the problems he mentions arise when the

¹⁹ These are conditionals like the following:

(i) If you are thirsty, there’s beer in the fridge.

where the truth of the antecedent is not

²⁰ The relevance of the context and pragmatic processing for appreciating the significance of a conditional is shown in the distinct results obtained concerning the *selection task* in Wason (1966) and Wason & Shapiro (1971) (see also Sperber et al. 1995 for interpretation of the results in the context of Relevance Theory).

cognitive/representational aspect of language processing is ignored. Without adopting the “promiscuously” pluralistic ontology of *Situation Semantics* (Barwise & Perry 1983), we can consider for inclusion in our representations more cognitively realistic, localised parts of possible worlds, *situations* or *events* (see e.g. Kratzer 1989). Criticised by Stalnaker (1986: 120) as retaining some representationalist biases, Barwise & Perry (1985) do mention that cumulative attribution of properties to *situations* seems a much more psychologically plausible approach to the acquisition of information than a theory postulating gradual reduction of an infinite set of possible worlds as assumed in possible world frameworks (see e.g. Stalnaker 1984). Since this seems correct to us, we will now consider an alternative semantic analysis for conditional sentences that employs quantification over alternative situations or eventualities.

2.b.3. *The eventuality/situation analysis*

The employment of partial objects, situations or events, as part of the semantic ontology has been employed for the semantics of naked infinitive reports: situations/eventualities can be the objects denoted by arguments of some perception verbs (see e.g. Barwise 1981 Higginbotham 1983):

(83) John saw [Mary kick Bill]

In addition, situations can be the arguments of causal relations:

(84) What caused the fight was [Mary kicking Bill]

Portner (1992) employs situations in the analysis of the semantics of gerunds, infinitives and subjunctives. It seems therefore that there is adequate linguistic motivation for the presence of situations in the logical forms derived by the processing of linguistic strings. In the domain of conditionals, situations have been employed (Kratzer 1989)²¹ in the computation of the *similarity* between worlds required for the evaluation of counterfactuals. From the present point of view, Kratzer’s situations seem to provide the appropriate

²¹ For some of the distinctions between this approach and Barwise & Perry’s Situation Semantics (e.g. Barwise & Perry 1981) see Portner (1992).

entities that underpin the operation of the pragmatic mechanism which must be employed for the evaluation of such conditionals and her approach delineates some of the aspects of the task that must be performed (the context-sensitive computation of similarity, guided by relevance theoretic assumptions, is explicated in Papafragou 1996, 1998, 2000). Moreover, quantification over situations, rather than worlds, can be taken as the common basis underlying subjunctive/counterfactual and indicative conditionals. As Kamp (1988) points out “many conditionals, while involving quantification over some other parameter, (say time), are nonetheless understood as pertaining to the actual world only. Such conditionals cannot be represented as material implications simpliciter, and yet they are ‘extensional’ in the loose sense that their truth values are determined exclusively by what is actually the case.” (Kamp *ibid*: 72). Stalnaker’s unified account of indicative and subjunctive conditionals might be misleading in this respect. It has been pointed out that the analysis of indicative conditionals by means of consideration of alternative worlds (as in e.g. Stalnaker 1975b) gives counter-intuitive results because evaluation of such conditionals by speakers and hearers seems to only take into account what is true in one world, the actual world. In contrast, subjunctive conditionals are explicitly marked as requiring consideration of alternatives to the actual world and therefore only those should involve consideration of alternative worlds (Gibbard 1981, Abbot 2004). Lewis (1973/1986: 3) maintained that distinct analyses should be given to indicative and counterfactual/subjunctive conditionals because of the distinct intuitive truth-values of the following:

(85) If Oswald did not kill Kennedy then somebody else did: *True*

(86) If Oswald had not killed Kennedy then somebody else would have: *probably False*

Lewis assumed that the material implication analysis could be suitable for simple indicative conditionals (Lewis 1986: 152-156). Nevertheless, the combination of quantificational adverbs like *mostly* or *usually* with *if*-clauses led Lewis (1975) to reject the material implication interpretation at least for these specific cases:

(87) Usually if Mary's cat eats porridge she is happy.

Following Kratzer's (1986) reformulation of Lewis' argument to involve situations²², suppose that the adverb *usually* corresponds to a quantifier *MOST* and that the latter quantifies over events or situations in the world. A semantic representation for (87) which follows closely surface structure would be as follows:

(88) $MOST\ s. [\text{Mary's cat eats porridge in } s] \rightarrow [\text{Mary's cat is happy in } s]$

The interpretation of such a representation would come out as: for most situations s it is the case that if Mary's cat eats porridge in s then Mary's cat is happy in that situation s . Kratzer (and Lewis) argue that this does not represent the right truth conditions under a material implication interpretation of \rightarrow : Suppose that there are just 1.000.000 situations in the world. 2000 of these situations are situations when Mary's cat eats porridge. In all of these 2000 situations Mary's cat is not at all happy. However all the other 998.000 remaining situations are situations where Mary's cat does not eat porridge. She might for example eat fish or play with the other cat or not be involved in the situations at all. Since all these remaining situations satisfy the description "Mary's cat does not eat porridge", i.e. the negation of the antecedent of the conditional inside the scope of *MOST*, then these situations, under the material implication analysis, verify the conditional. Since most situations (998.000) verify the conditional whereas 2000 situations falsify it, the whole sentence should come out as true although intuitively the sentence is false given the facts described. As a result, Kratzer, following Lewis' suggestion, argues that the material implication analysis of conditionals should be abandoned for these cases and instead the *if*-clause should be taken as having no other contribution to the meaning of the sentence than indicating the restrictor of the quantifier *MOST* contributed by the adverb *usually* (for

²² Lewis rejects the claim that the quantification is over events/situations because there are cases involving mathematical statements like the following which, in his view, cannot be seen as involving specific events:

(i) A quadratic equation usually has two solutions

Lewis MOST was to be analysed as an unselective quantifier over cases, i.e. assignments of values to any free variables in the representation):

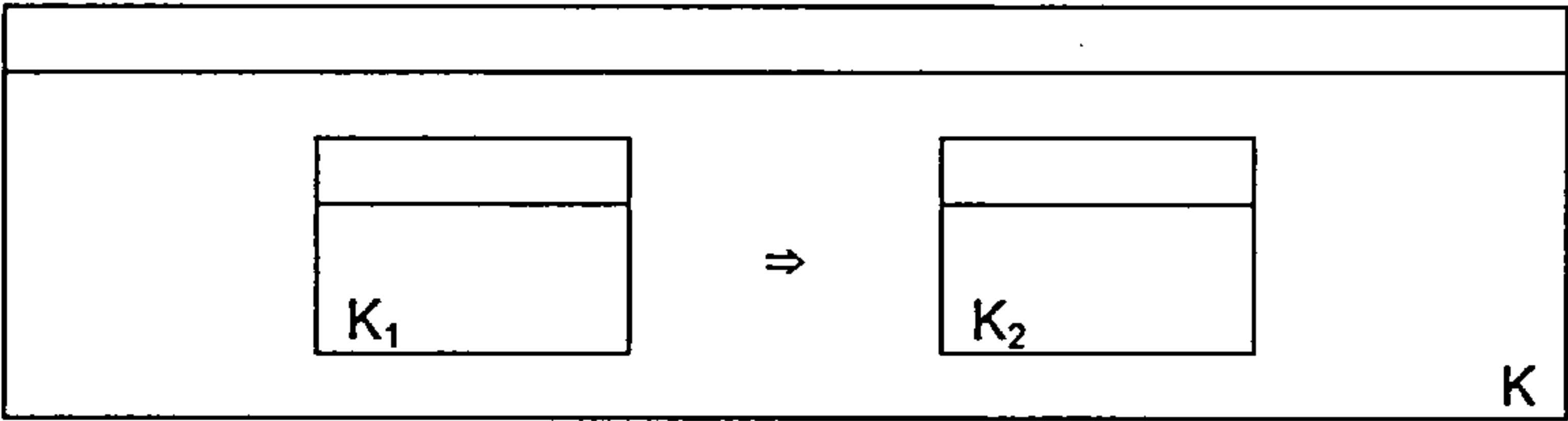
(89) MOSTs [Mary’s cat eats porridge in s] [Mary’s cat is happy in s]

Kratzer (1978, 1986, 1991) then goes on to extend this analysis to all uses of conditionals, subjunctive and indicative alike. In her analysis *if*-clauses always contribute a restrictor to a quantifier. This quantifier might be an adverb of quantification as above, or a modal as in (90) below or an implicit necessity operator when there is no overt quantificational element (in cases of “bare conditionals”):

- (90) If John comes he must greet Mary
- (91) MUST [John comes] [John greets Mary] =
- (92) \forall_w [John comes in w] [John greets Mary in w]
- (93) If John is upset he blames Mary
- (94) \Box [John upset] [John blames Mary]
- (95) \forall_w [John upset in w] [John blames Mary in w]

Lewis’s quantification over cases (rather than situations) and Kratzer’s analysis of conditionals as always restricting a modal operator are combined in the initial DRT frameworks presented by Kamp (1981) and Heim (1982). Following Kratzer and Lewis, Heim (1982) adopts an analysis of conditionals as always (implicitly or explicitly) quantifying. Logical forms for conditional sentences are seen to involve unselective operators which bind all the free variables in their scope. In the closely related DRT framework of Kamp (1981) conditional sentences (and universal quantification) are analysed as causing ‘box-splitting’, that is, introducing in the main DRS K two subordinate DRSs K_1 and K_2 related by the connective \Rightarrow :

(96)



The semantics assigned to such structures is also equivalent to unselective universal quantification over the values assigned to free variables in the antecedent box.

Kamp's and Heim's analyses are motivated by the need to account for certain puzzles in the theory of anaphora, namely, the interpretation of *donkey sentences*. The original observation due to Geach (1972) was that indefinites inside the antecedent of a conditional must be interpreted as universally quantified:

(97) If a farmer buys a donkey he feeds it.

(98) $[\exists x. \exists y. \text{farmer}(x) \wedge \text{donkey}(y)] \rightarrow \text{feed}(x, y)$

(99) $\forall xy. [\text{farmer}(x) \wedge \text{donkey}(y) \wedge \text{own}(x, y)] \rightarrow \text{beat}(x, y)$

Since the material implication analysis of conditionals combined with the analysis of indefinites as existential quantifiers results in a translation of (97), the logical form in (99), which does not reflect the intuitive truth conditions, Heim (and effectively Kamp too) adopt the unselective quantification analysis which takes *if*-clauses as contributing restrictors in tripartite quantificational structures. This, in combination with an analysis of indefinites and pronouns as contributing free variables (or 'discourse referents' in Kamp 1981) that can be bound by the unselective quantificational operators allows for a successful treatment of donkey sentences. The successful treatment of donkey sentences is a major achievement of DRT. However, as Heim (1990) points out, the success of this account is not necessarily tied to the unselective quantifier analysis of quantificational terms and the conditional operator. In order to solve certain problems that arise under the above DRT assumptions, Heim proposes to resurrect the E-type analysis of unbound pronouns in combination with a situation/event semantics. Unbound pronouns like the ones in (98) are not interpreted any longer as bound variables but instead as definite descriptions in disguise (cf. the *E-type* analysis of Evans 1981, Cooper 1979). The problems that had been pointed out by Heim (1982) for such an analysis are to be solved by recourse to the semantics developed by Berman (1987) who adopts Kratzer's situation semantics (see also Farkas

1997²³). In this type of semantics worlds are not disposed of but the ontology is extended to include situations so that propositions are properties of situations or sets of situations. In Berman's implementation, *possible situations* are taken to be basic entities in the model. Thus, models come with a set S of possible situations. There is a partial ordering, \leq , in the set S relating members of S to each other in such a way that for any situation $s \in S$ there is a unique maximal situation (a *world*) of which s is a part, i.e. each situation belongs to one unique possible world. Heim's basic idea then is to abandon the problematic *unselective quantification* view of DRT and let operators like Quantificational Adverbs and the conditional to quantify selectively over situations. In this analysis every predicate now comes from the lexicon equipped with an additional situation argument. The inclusion of situations in the semantics, in association with an (admittedly problematic) assumption of "minimality" of quantified situations, is taken to solve earlier criticisms of the E-type approach to unbound pronouns. In cases like the following the implausible prediction of the E-type analysis when combined with a uniqueness assumption regarding the semantics of definite descriptions and a universal quantification over worlds analysis of conditionals, was that for the sentence to be true it is required that exactly one man should be in Athens in each possible world:

(100) If a man is in Athens then *he's* not in Rhodes.

(101) $\forall w$. If a man is in Athens in w then
 the man who is in Athens in w is not in Rhodes in w .

With the advent of situations the uniqueness presupposition that is assumed to accompany definite descriptions can be taken to hold only with respect to the (minimal) situations considered in the interpretation of such sentences. Additionally, according to Berman (1987) and Ludlow (1994), situations are needed for the resolution of other problems associated with the standard DRT analysis, like the *proportion problem*, which can be approached with a combination of the situation analysis and contextual enrichment of the

²³ as in Ludlow (1994) the use of the term "event" for these entities does not imply that they are necessarily spatiotemporal.

specification of the type of situations quantified over (see Berman *ibid*: 56-57, Ludlow 1994, cf. Heim 1990). We find these arguments persuasive and, therefore, as providing one more reason for the inclusion of situations in the logical forms of such sentences.

2.b.4. *The relevance of the situation semantics for the present analysis*

The interpretation of definites in DS does not raise problems like those seen above with the E-type analyses since definites in DS are taken as essentially anaphoric and not implying any uniqueness, just the immediate accessibility of their intended content. Moreover, as we are going to see later, in DS, indefinites and quantificational terms are seen as supplying terms which can be re-used for the completion of the underspecified content contributed by pronouns. As we are going to see later, these assumptions can provide solutions to the donkey cases without adopting either the unselective quantification assumption nor the *E-type* analysis for pronouns with the associated problems for encoding some *minimality* condition over the situations quantified over. Nevertheless, the interpretation of conditional sentences requires that we provide a semantic representation that reveals the connection between antecedent and consequent, accommodates the intuitive universal force, and which moreover provides an explanation for their similarities with relative clauses pointed out earlier. For this reason, we will adopt the widespread assumption that semantic representations of natural language sentences involve situation arguments (this assumption under a slightly different implementation has been argued for in Perrett 2000 and Kurosawa 2003 in the context of DS). The situation argument will be bound by the term binder introduced by the lexical entry associated with the word *if*. In effect we are implementing in a DS representational guise some of the assumptions developed by Lycan (2001) in combination with Kratzer's situation semantics taking for granted relevance theoretic assumptions as regards the construction of appropriate restrictors for quantificational elements. Many researchers have analysed conditionals as uniformly

expressing quantifications over situations, events or cases (Geis 1985, Lycan 1984, 2001, Ludlow 1994, Schein 2001, the possibility is also raised in Schlenker 2005²⁴). In Lycan's analysis, which is motivated by the syntactic analysis of natural language conditional sentences, indicative or subjunctive conditionals are uniformly translated as involving universal quantification over events (or situations). For example, a linguistic string with the schematic form in (102) below can be given the logical form in (103):

- (102) If P then Q
 (103) $\forall e (\text{In}(e, P) \rightarrow \text{In}(e, Q))$

The situations or events quantified over are taken as possible states of affairs. However, this analysis is essentially context-dependent. The events or situations over which the quantifier ranges are what Lycan calls "real and relevant possibilities" in the context. This is explicated to mean that (a) the situations quantified over are epistemically envisaged in the context of use, and (b) the situations are "relevant" in the sense of involving the antecedent or the consequent. As Lycan shows these assumptions can solve several of the problems arising from the material implication analysis. The context dependency of the quantification is explicitly indicated in the logical form by including a parameter *R* which represents the set of situations over which the quantification is restricted:

- (104) $\forall e \in R. \text{In}(e, P) \rightarrow \text{In}(e, Q),$

The restriction of the quantification to situations that are epistemically envisaged and relevant is the analogue of Stalnaker's selection function and of Lewis' similarity relation. In addition it can be seen as expressing the reinterpretation of the Kratzerian notions of *conversational background/modal base* and *ordering source* offered by Papafragou (1996, 1998, 2000).

²⁴ Situation-semantics accounts differ from the (usually) Davidsonian event-semantics accounts in that as Portner (1992) in Davidsonian accounts there is no connection between situations/events and propositions. However, as Chierchia (1995: 100) points out, it is difficult to find crucial evidence that determine the choice between one option or the other (although Portner 1992 provides some evidence for the Kratzerian situation account). Therefore, following Chierchia, I will conflate the two notions here as, for the issues considered, the distinction does not matter significantly.

In the present thesis, we will adopt logical forms similar to Lycan's although presented in a structured tree format in accordance with DS assumptions. The parameter R employed by Lycan can be given a suitable expression in DS as an anaphoric element which must be resolved in context in accordance with assumptions explicated by pragmatic theories like Relevance Theory. For this reason we do not think that we need to encode any constraints on R , as, in a way similar to pronouns, the resolution to an appropriately determined set of situations will be provided by the context of utterance under the guidance of the principle of relevance. It will then be shown that such representations are adequate for dealing with the problems raised by donkey sentences. Moreover the analysis extends to the *telescoping* cases which are problematic for the classical formulations of DRT, without having to introduce any further covert operations or additional types of anaphoric expressions (cf. Roberts 1989):

- (105) Every student walked to the stage. He took his diploma, shook hands with the Dean and left.
- (106) Every chess set comes with a spare pawn. It is taped to the bottom of the box

The account will also extend to cover anaphoric links in cases where reversal of the order between antecedent and consequent has been claimed to change the anaphoric possibilities between the terms introduced:

- (107) Every student_i will be rewarded if he_i is on time.
- (108) *If every student is on time he will be rewarded.

The DS account of quantification and anaphora treats both indefinites and other quantifiers uniformly as contributing logical names which once introduced remain available for the processes of substitution which deal with the resolution of anaphoric phenomena. In that respect, the presumed ungrammaticality of (108) can be seen as problematic for DS. However, it will be shown that data like the following attested sentences challenge the standard assumptions made in other frameworks whereas they are in fact predicted to occur under DS assumptions of quantification and anaphora:

- (109) If *every vote* counts then *it* should count in every county
- (110) If *every indictee* knew he was indicted, *he* would have time to hide or destroy evidence.

Another issue that will be addressed is the fact that since terms have to be introduced in order to be available for anaphoric substitution, DS has to provide the means for processing cases where the pronoun is encountered before the antecedent:

- (111) [If she_i is hungry], Mary_i yells at Bill. (from Iatridou 1991)
- (112) [If her_i child is late from school] every mother_i is upset
- (113) [If he_i is late] a man_i will start making excuses
- (114) If you give him_i enough opportunity, every senator_i, no matter how honest, will succumb to corruption (from Culicover & Jackendoff 1997)
- (115) [Which of his_i pictures] does every photographer_i dislike?
- (116) [Which woman that he_i used to dislike] does a friend of yours_i flatter all the time?

These cases can be accommodated by exploiting the standard mechanisms that DS provides for the processing of temporarily unintegrated constituents of the logical form. As a side effect, we will see that the assumption of situation arguments construed as quantificational terms provides the appropriate means for the resolution of pronominals like *it* below:

- (117) If John sings arias, *it* bothers me a lot
- (118) It bothers me a lot, if John sings arias at home all day.
- (119) *John sings arias bothers me a lot

In chapters 6-8 we will see in more detail how the analysis of the parsing and eventual structure assigned to conditional sentences proposed deals with all these issues. But first of all in the next few chapters we will introduce the framework of DS as presented in Kempson et al. (2001) and Cann et al. (2005).

CHAPTER 2

INTRODUCTION TO THE FRAMEWORK: DYNAMIC SYNTAX

1. Preliminaries

The framework of *Dynamic Syntax* (DS) provides a formal explication of the linguistic processes involved in the interpretation of utterances. These processes are modelled in such a way as to interact directly with general mechanisms of reasoning and inference, the latter operating according to principles expounded by pragmatic theories (as, e.g., in *Relevance Theory*, Sperber & Wilson 1986/1995). For the purposes of providing a common interface with such systems, DS adopts the assumptions that underpin *representational theories of mind* (see, e.g., Fodor 1981). The basic tenet of such theories is that the functioning of the mind in tasks like human reasoning and the causation of behaviour can be modelled as a “syntax-driven machine” (Fodor 1985: 94) operating through the formal manipulation of structured mental representations expressed in an internalised *language of thought* (LOT). The formal properties of LOT representations that are relevant to these tasks are the intrinsic structural properties of hierarchically organised complexes of atomic concepts (*propositions*). The semantic properties of LOT representations are the means by which effective interaction between the human organism and its environment is achieved.

The adoption of this view by DS has the consequence that natural languages are taken neither as directly semantically interpretable nor, therefore, as the vehicles directly supporting inferential tasks. Rather, in DS, the natural language apparatus is modelled as a system which, in interaction with contextual resources, allows the assimilation of specialised, externally induced stimuli having the form of utterances. Processing of these specialised stimuli eventuates in the construction of structured LOT expressions over which inference can be defined and by inducements of which information can be exchanged (in that respect natural language is therefore modelled as an

'input system' in Fodor's 1983 sense). From this point of view, linguistic signals do not exhibit any relevant structure beyond the time-linear (left-to-right) order of presentation: the "syntactic" properties that other frameworks invoke in order to explain phenomena pertaining to properties of natural language expressions are now redefined as supervening on two distinct systems and their interaction: (a) the language-particular, specialised procedural resources which allow the progressive and monotonic construction of LOT representations as the content of utterances; and (b) the intrinsic structural properties that these LOT expressions exhibit. For example, as regards (a), the *words* of a natural language are seen as specialised triggers that can not only contribute conceptual elements in a structured LOT representation but also, in conjunction with general processing rules, create and anticipate the structure that incorporates such elements. Regarding (b), the structure created through the operation of words and rules, presented in the form of *trees*, provides the basis for explicating intuitions about constituency and the resolution of structural ambiguities. The DS formalism is thus designed as a model aiming to show that a characterisation of the progressive interaction between contextual and structural processes provides adequate explanations for often noted syntactic and semantic phenomena.

Before going into the details of the formalism, here is a quick summary of what we can expect: the main idea which the DS system implements is that natural language denotational content can be represented in the form of binary linked trees. The nodes of these trees are annotated ('decorated') with the terms of a logical language. The representational language of choice is constituted by epsilon calculus expressions built on the basis of the combinatory resources provided by the lambda calculus. The formulae of this logical language are accompanied by *labels*, i.e. pieces of information facilitating the parsing of the string or adding further content dimensions. The definition of the tree-structure and the node decorations, the *data structures* described by the DS model, will be presented immediately below. An important distinctive characteristic of DS is that it models the progressive

construction of such trees and decorations. This necessitates the additional definition of (a) a set of structures that includes partial objects, i.e. incomplete trees with partial decorations, ordered according to how much such partiality/incompleteness they exhibit; the definition of those constitutes the *declarative structure* of the DS model; (b) a set of transition rules that monotonically map partial incomplete objects to more and more complete ones with the eventual aim of reaching a defined point of termination, a fully decorated tree structure. The definition of the actions that gradually perform this task constitutes the *procedural structure* of the model²⁵.

2. Declarative Structure

2.a. Tree structures

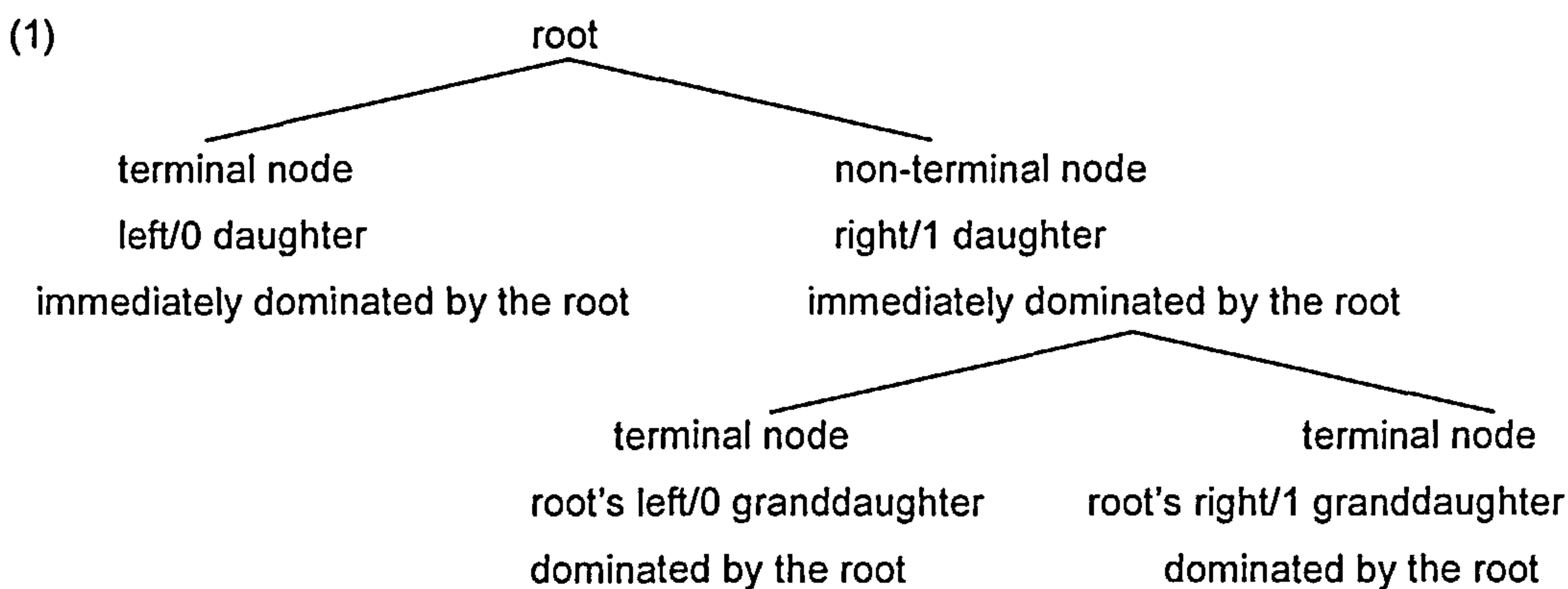
Speakers' linguistic intuitions and the study of how natural languages operate reveals evidence, some of which will be discussed later, that linguistic processes make reference to and are constrained by notions of local domains and hierarchical structure. The most prominent among these domains is the one defined by a predicate and its arguments (although other restricted environments can also be shown to be relevant, for example those defined by permitted anaphoric dependencies; we will take those up later). For the purpose of circumscribing the configurational properties of a domain defined by a propositional formula and its progressive compilation by natural language input, DS proposes that the parsing process operates by developing binary-branching tree structures²⁶. These structures provide the scaffolding on which the semantic content of the string, a propositional expression, is unfolded in the form of node 'decorations'. Thus the nodes of DS trees are inhabited by the terms of a logical language, the language

²⁵ These two aspects of the DS model, declarative and procedural, are based on the type of models defined for PDL (Propositional Dynamic Logic) enriched with *requirements* and an element of *goal-directedness*. Thus the distinction between the two parts of the DS parsing model expresses the customary distinction between propositions holding *at* states and actions which hold *at pairs of* states. For simplicity we suppress all such formal definitions below (see Kempson et al. 2001: 268-325 for details).

²⁶ This is a simplification at this stage as there are larger domains also defined, e.g. those relating to the parsing of clausal adjuncts (defined in DS as *LINK* structures as we will see in the next chapter).

chosen to represent the semantic content of natural language utterances. The asymmetry of a term's position on the propositional tree relative to other terms can then be taken to correspond to its asymmetric status with respect to other terms in the same domain thus enabling the definition of distinct grammatical roles and functions, e.g. derivative characterisations of the traditional notions 'subject', 'object' etc²⁷. Moreover, the utilisation of the tree format gives immediate access to relations between nodes which can be exploited for encoding the interdependency of information among the components of complex propositional representations (for example, as we will see later, the structure of the tree is crucially involved in the definition of permitted patterns of *extraction* or *copying*). Let's now see the formal definition of tree format employed by DS.

As usual, essential for the definition of a tree format is a set of nodes with the relation of *immediate dominance* potentially holding among pairs of them. Derivatively, relations like *dominance*, *mother*, *daughter*, *granddaughter* etc. can be defined. Additionally, since there is a need to distinguish between the two sister nodes at each level, binary trees are (arbitrarily) ordered in DS so that we talk about a left and right daughter relation, or a 0 and 1 daughter relation. Every tree has a node which is unique in that it is the only node that has no mother, the *root*. *Terminal nodes* are distinguished from the internal (*non-terminal*) ones in that they have no daughters of their own:



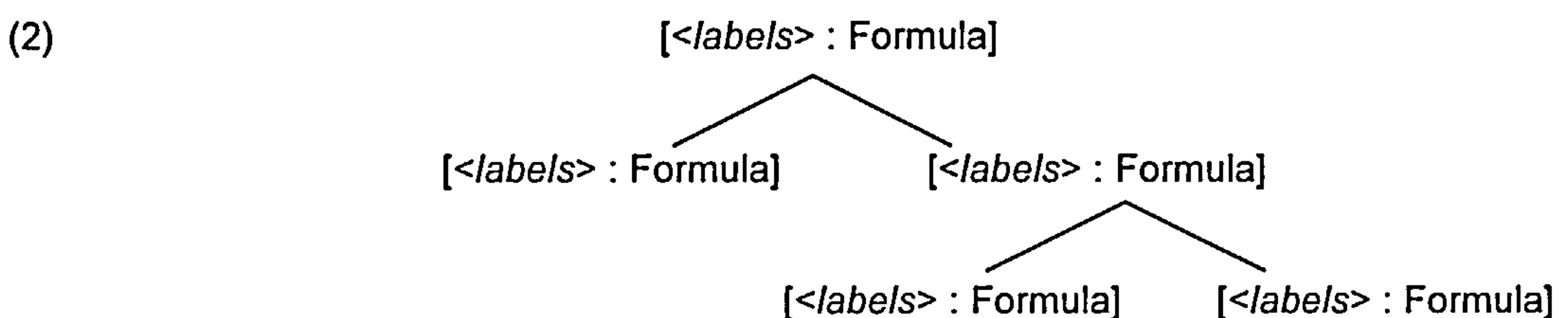
²⁷ This hierarchical organisation can also be employed in order to give a structural characterisation of the notion of *co-argument* cf. e.g. Pollard & Sag (1992)

From an abstract point of view, trees can be seen as Kripke frames with the nodes standing for the worlds/points and the tree-relations among them taken as distinct accessibility relations. For this reason a modal language provides an appropriate vocabulary to describe such constructs. DS uses exactly such a language, *LOFT*, which will be discussed later.

The bare tree skeleton described above serves the important function of hosting, at each node, annotations ('decorations') responsible for combining and enriching the eventually derived formula. We will see those next.

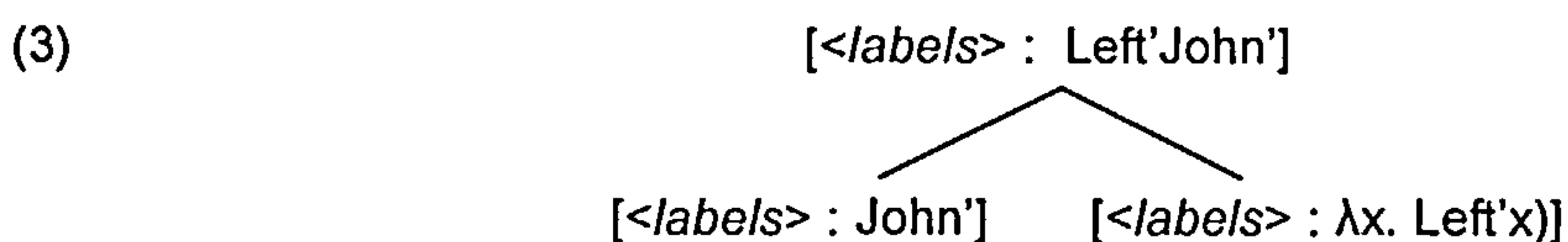
2.b. Decorations

In DS, the binary tree format supports a *Labelled Deductive System* (LDS) in the sense of Gabbay (1996). An LDS standardly integrates distinct logical systems and vocabularies with the overall formalism defining the logic of their combination and potential controlled interaction. Accordingly, in DS, the decorations on the nodes of the binary trees are represented by *declarative units*, that is, pairs of a sequence of labels followed by the main target of the computation, the formula value:



As is natural for an LDS employed for natural language processing, the *Formula* annotations play a central role in that they are used to express the conceptual content (LOT terms) that processing of linguistic input gives access to. This content can be complex and is compositionally derived by systematically integrating the contribution of simpler LOT atoms whose content has potentially been enriched and adjusted by being processed in a

particular contextual environment (cf. Carston 1998). Accordingly, DS defines as the main goal driving the parsing process the eventual construction of a complete composite Formula value decorating the root of a binary-branching tree. The composite structure of this formula is explicitly recorded on the tree nodes as the term-structure of the lambda expression that annotates the root²⁸. For illustration consider the type of tree derived by parsing the string “John left” (the conceptual content lexical items give access to is indicated by primed expressions):



This compositional structure attributed to the propositional content that natural language strings contribute accounts for one aspect of the often-noted productivity and systematicity of the linguistic system (its *compositionality*). However, the derivation of such content is crucially developed in conjunction with interacting context-integrating processes (which are modelled as *pragmatic actions* in DS). This interaction which, for DS, models the use of language in particular utterance situations provides the foundation for a characterisation of the adaptability and flexibility of natural language expressions, expressions which can be effectively used in diverse situations serving distinct aims and purposes in each context (the “efficiency of language” Barwise & Perry 1983).

We have now described the objects that model what DS considers as the representations constructed as the result of parsing a linguistic string. In order to be able to talk about these modelling objects, describe them and, more importantly, recount their progression from incomplete to complete structures we need a language and a logic where the requisite transitions can

²⁸ The λ -calculus supports expressions from the epsilon-calculus to account for quantification; see chapter 3.

be defined. The DS formalism operates by manipulating descriptions of such trees expressed in a formal language, the language *DU*.

3. The language *DU*

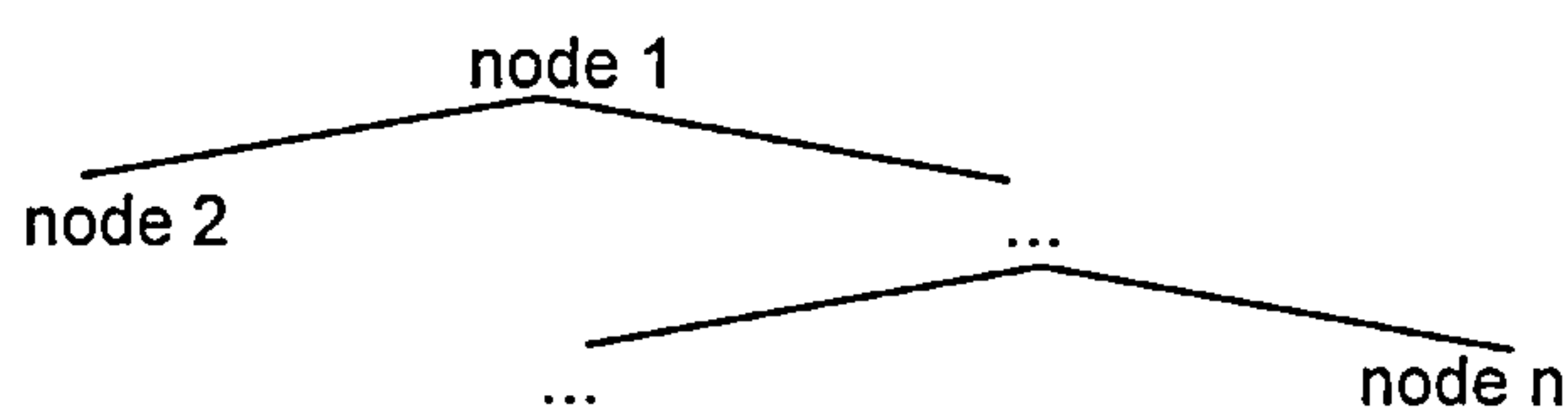
Trees and their decorations are described in DS by the *DU language*. In DU terms, a tree-node is described as a set which contains formulae expressing facts being true of that node (a *node description*). Such information about a node is encoded by using predicates describing the decorations that inhabit the node and some other of its pertinent properties, for example, its exact position on the tree, its relations with other nodes, etc. The description of an entire tree as expressed in DU is then another set containing a number of such sets of node descriptions:

(4)

A (schematic) *tree description*:

$\{ \{node\ description\ 1\}, \{node\ description\ 2\}, \dots, \{node\ description\ n\} \}$

and its (schematic) model:



Let's now see some of the predicates that DU employs to talk about nodes and trees.

3.a. The predicate *Fo*

The most important information a node carries is the LOT concept that it contributes to the final propositional representation. Such concepts, as we said, are encoded on the tree decorations as terms in a typed lambda calculus. Therefore the decorations on tree-nodes that encode such concepts will be functions, their arguments and the results of function application over the formula values of sister nodes:



In the DU language, the formula values appearing on each node are indicated in the descriptions of these nodes by use of the monadic predicate $Fo(\dots)$. The arguments of this predicate are taken from the set D_{Fo} which contains terms of a typed lambda calculus. For example, the description of the tree in (5) by DU will be a set containing three other sets; each of the latter contains a description expressed by means of the predicate Fo :

$$(6) \quad \{ \{ \dots, Fo(\text{Left'John'}) \}, \{ \dots, Fo(\text{John'}) \}, \{ \dots, Fo(\lambda x. \text{Left'x}) \} \}$$

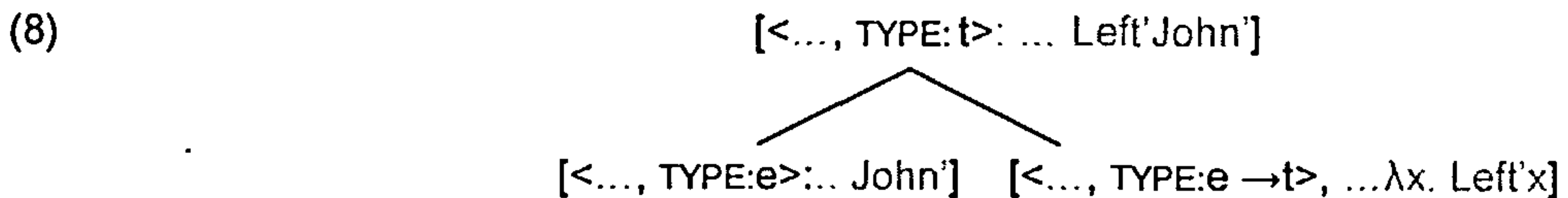
3.b. The type predicate Ty

An additional type of information encoded on DS trees is the logical type of each formula value. Such logical types drive the eventual bottom-up derivation of the proposition at the root node by taking advantage of a definition of types as formulae in a conditional logic: we can take the logical types as equivalent to propositional premises in a natural deduction system; by applying Modus Ponens on two such premises another premise (type in our case) can be deduced:

$$(7) \quad \frac{e, e \rightarrow t}{t}$$

This notion as it is implemented in the DS system invokes Modus Ponens on the type values of the two daughters of a node so that the type value of the mother can be deduced. The rules define that there should be an associated process of functional application concerning the Fo values on the respective nodes so that the result will be deposited at the mother as its own Fo value. DS makes use of a predefined number of logical types (e , t , cn and a small finite number of their derivatives) determined by the lexicon of the language.

These types accompany the formula values as *Labels* (note that there are no productive rules which construct types as in some Categorical Grammar formalisms). The tree above in (5) can be shown more completely with its accompanying type labels as follows:

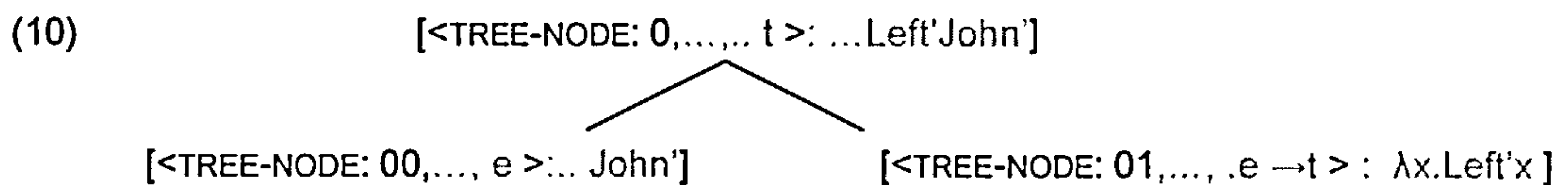


Now in the description language DU, the predicate that indicates the type of the formula value at each node is the monadic predicate $Ty(\dots)$. The arguments of this predicate can be found in the set D_{Ty} . If we add the descriptions of these labels to the tree description above in (6) this is the more complete tree description that ensues:

$$(9) \quad \{ \{ Ty(t), Fo(\text{Left'John'}) \dots \}, \{ Ty(e), Fo(\text{John'}) \dots \}, \{ Ty(e \rightarrow t), Fo(\lambda x. \text{Left'x'}) \dots \} \}$$

3.c. The predicate Tn

Other types of Labels, some of which will be discussed later, are also defined. The contents of these labels cater for, e.g., gender specifications, clause type, scope etc. and act as controls in the process of constructing the eventual Fo value. One important among those is the label encoding the exact *address* of the node with respect to the root. The DS binary trees are (arbitrarily) ordered so that we can distinguish between two sister nodes. So sometimes we talk about the left daughter and the right daughter which, more formally, are distinguished from each other by means of address-labels consisting of sequences of zeros and ones. Starting with the address 0 for the root node, by convention, the left branch, the argument daughter, is always labelled by appending a 0 to the address sequence of its mother whereas the right branch, the functor daughter, is always addressed by appending 1. As an illustration, consider how the tree in (8) should be represented now with the addresses on the nodes included:



The left daughter of a node always designates by convention the argument daughter whereas the right branch accommodates the functor. In the language DU for describing such trees, the monadic predicate $Tn(\dots)$ is used to refer to addresses. There is also a pointer symbol, \diamond , which is a constant indicating which node is under development at each point in the parse. The following can be taken as a true description of the tree above:

(11)

$$\{ \{ Tn(0), Ty(t), Fo(\text{Left'John'}, \diamond) \dots \}, \{ Tn(00), Ty(e), Fo(\text{John'}) \dots \}, \{ Tn(01), Ty(e \rightarrow t), Fo(\lambda x. \text{Left'x}) \dots \} \}$$

This concludes our (rather partial) presentation of some of the data structures and their description language in DS. However, as we said earlier, a more effective description language for linguistic purposes requires enrichment of the DU language presented above with a modal logic so that we are able to address distinct points on the tree at each particular stage of parsing. The logic employed by DS is *LOFT*, as explained below.

3.d. The LOFT language

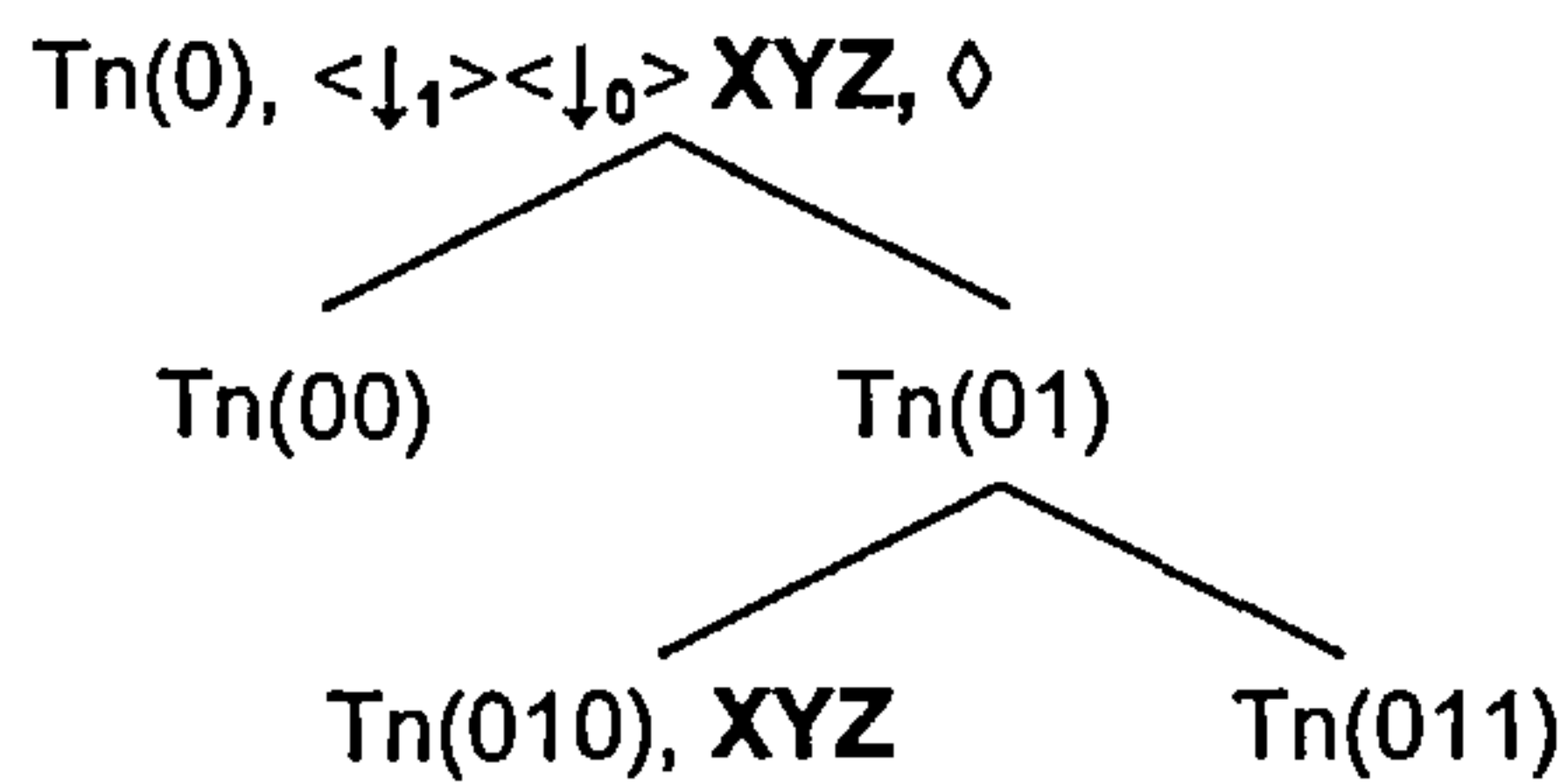
The use by DS of *trees* as linguistic content representations as well as the procedural point of view adopted requires a language to talk about trees, the relations between their nodes and, additionally, potential relations among distinct trees. For this reason, DS imports in the DU language the operators of a modal logic specifically designed to talk about trees, the *Logic of Finite Trees* (*LOFT*, Blackburn & Meyer-Viol 1994). Descriptions of trees expressed by means of this language offer the advantage that one can describe facts in any part of the tree from the perspective of any node in that tree. This ability

allows us to establish correlations and define constraints in the development of the tree at any point of processing. Let's see in more detail what LOFT can do for us.

The LOFT modalities that are used in DS are either existential, symbolised by $\langle \rangle$, or universal, indicated by $[]$. The angled brackets symbol, $\langle \rangle$, denotes existential quantification over nodes and can be read as "there is a node such that ..." whereas the square brackets symbol, $[]$, denotes universal quantification and can be read as "for all nodes ...". The operators will also indicate whether one talks about dominating nodes, dominated ones, the mother, the daughter or some other point on the tree. To encode all these relations between nodes, up and down arrow symbols, \uparrow , \downarrow are used. When the existential operator contains an upward pointing arrow, $\langle \uparrow \rangle$, the intended meaning is "at the mother of this node" whereas the down arrow, $\langle \downarrow \rangle$, means "at the daughter of this node" or "at the immediately dominated node". These arrows can be subscripted with 0 or 1 so that we can be even more specific about which of the two, left or right, daughters we are referring to. The left, by convention, the argument daughter, is indicated by $\langle \downarrow_0 \rangle$ whereas the functor, the right daughter, is indicated by $\langle \downarrow_1 \rangle$. To say "at the mother node" when the pointer is at the argument daughter we use the operator $\langle \uparrow_0 \rangle$. With the pointer at the functor node we use the symbol $\langle \uparrow_1 \rangle$ to talk about its mother (although since there is always only one mother for each node we can just as well use the upwards pointing arrow, $\langle \uparrow \rangle$ by itself). Moreover, we can also iterate these operators to express more complicated points of reference. For example, if we want to say that a decoration XYZ holds at the argument daughter of the current node's functor daughter (i.e. at the argument granddaughter) we can prefix XYZ with $\langle \downarrow_1 \rangle \langle \downarrow_0 \rangle$ to derive the specification $\langle \downarrow_1 \rangle \langle \downarrow_0 \rangle \text{XYZ}$, which can be read as "XYZ holds at the argument granddaughter"²⁹.

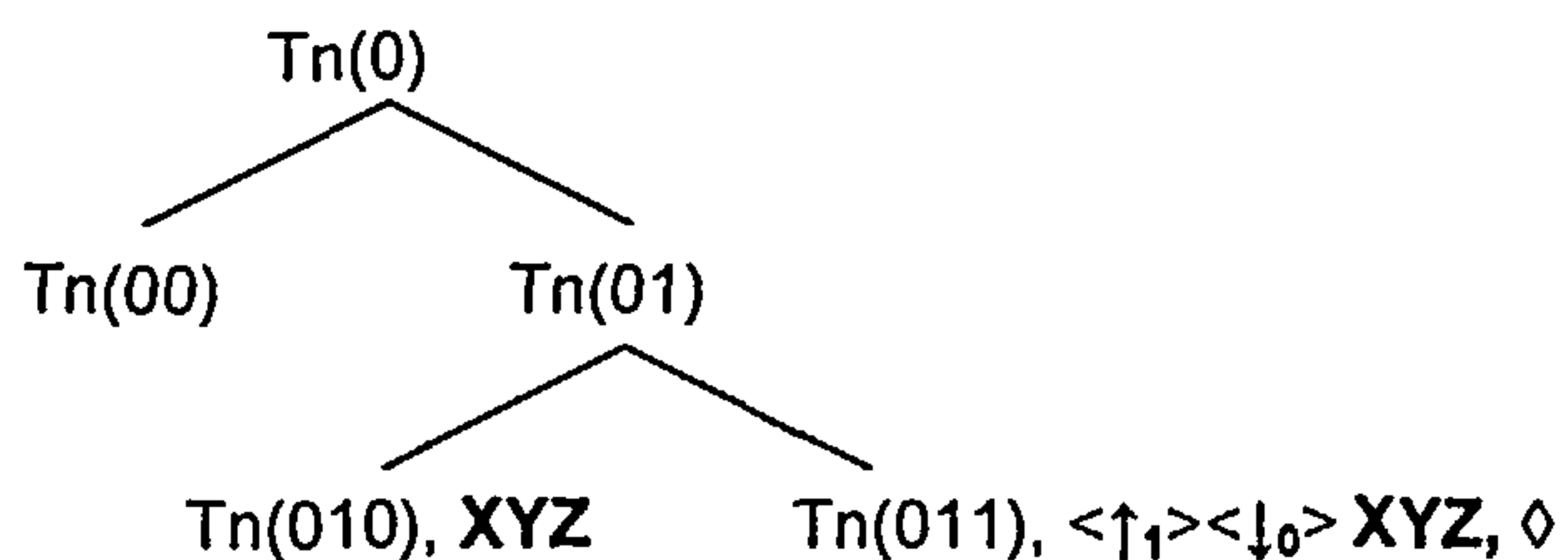
²⁹ For illustration purposes we are presenting here a DU tree description in a tree format instead of a set language format as it has been defined, which, strictly speaking, means committing the offence of mixing models with their descriptions. This is a practice which will be maintained from now on when no confusion is likely to ensue.

(12)



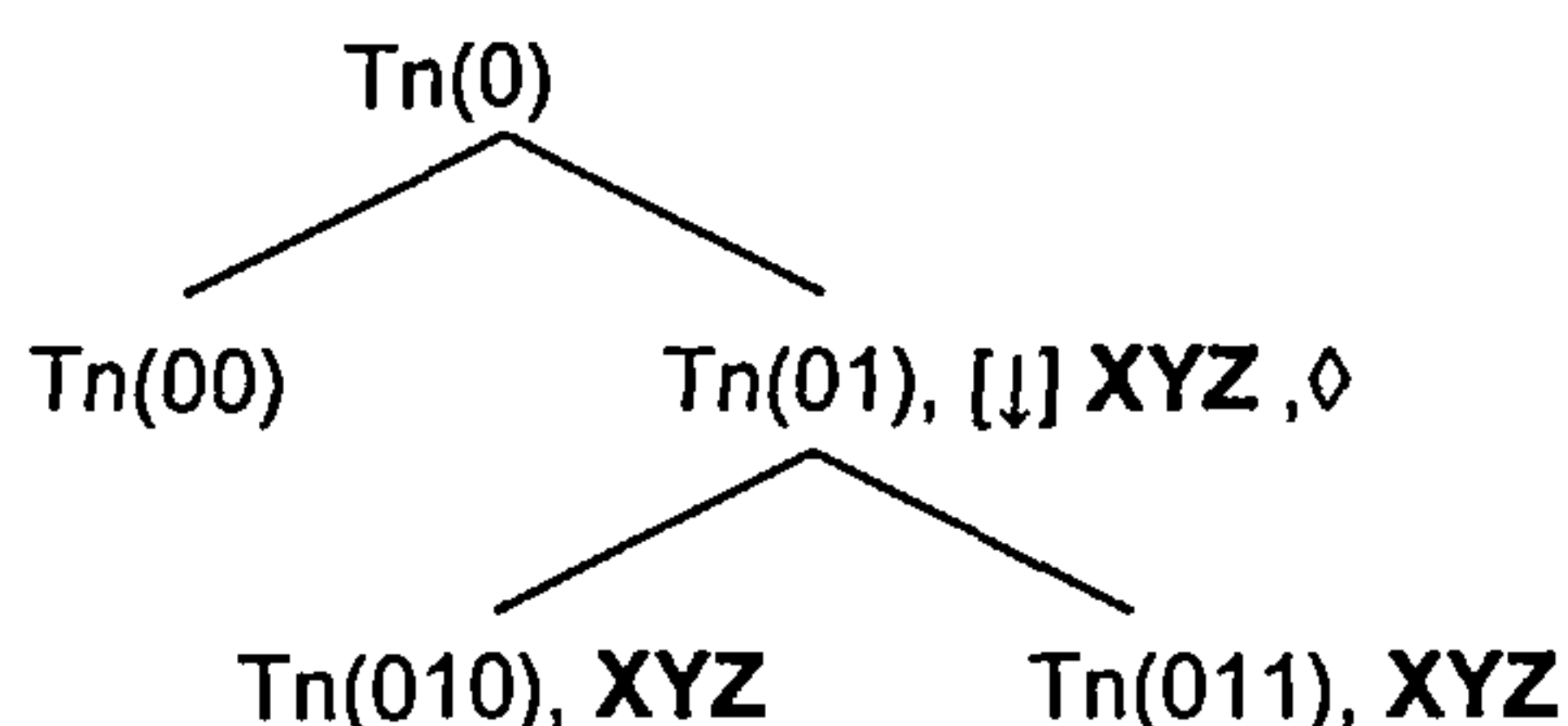
If we want say “at the argument daughter of this functor node’s mother, XYZ is a fact” we can symbolised it as follows: $\langle \uparrow_1 \rangle \langle \downarrow_0 \rangle \text{XYZ}$:

(13)



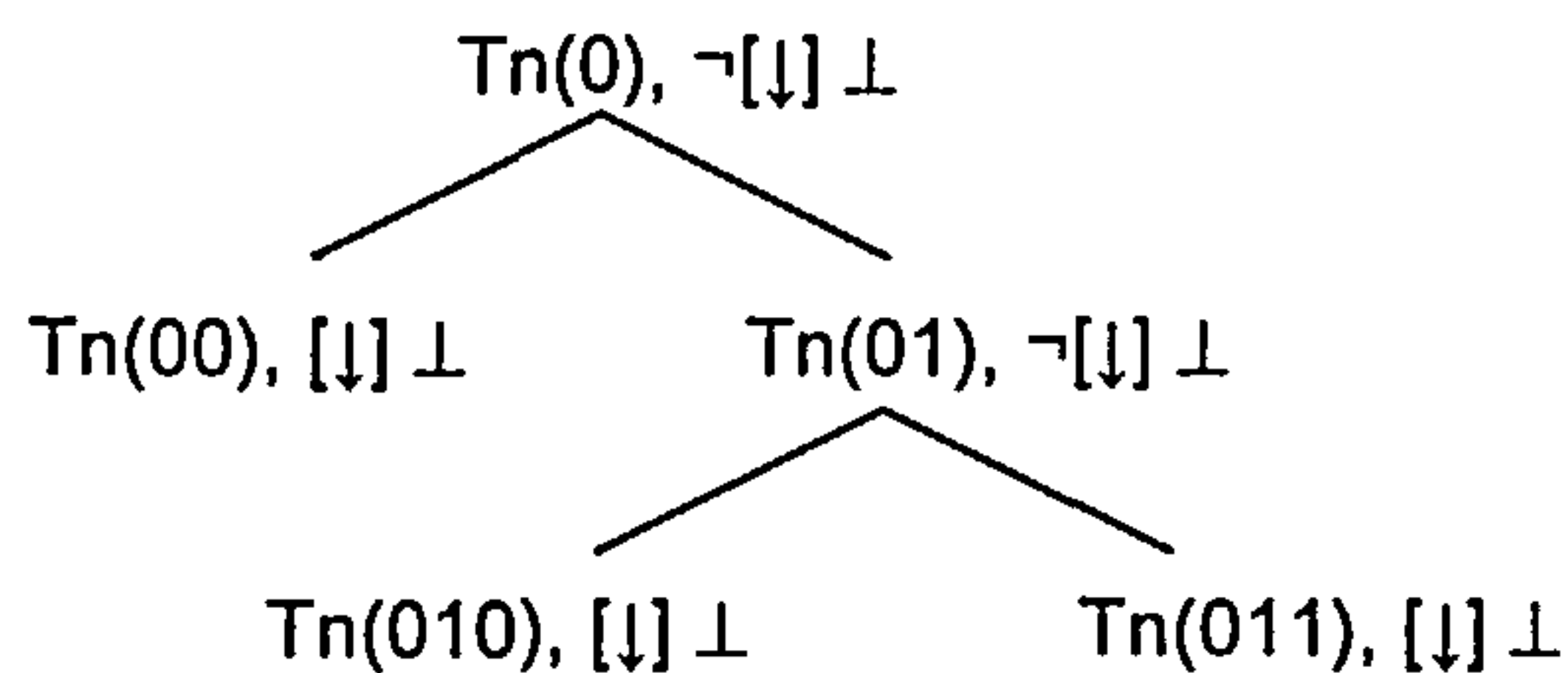
The same holds for the universal operator. By using the universal modality in combination with the arrows we can express statements about all daughters of a node. For example, the $[\downarrow] \text{XYZ}$ means “at all daughters of the current node, XYZ holds”:

(14)



Two more symbols that are added in the DU language to talk about trees are the verum, \top , which is true of any node on the tree and the falsum, \perp , which holds at no node. As an instance of the use of these symbols, consider the combination of the universal daughter modality with the symbol for falsum \perp , i.e. the annotation $[\downarrow]\perp$. Appearing on the description of a node this symbol indicates that this is a terminal node of a tree, that is, the node has currently no daughters and cannot be expanded further below by the addition of another piece of tree structure:

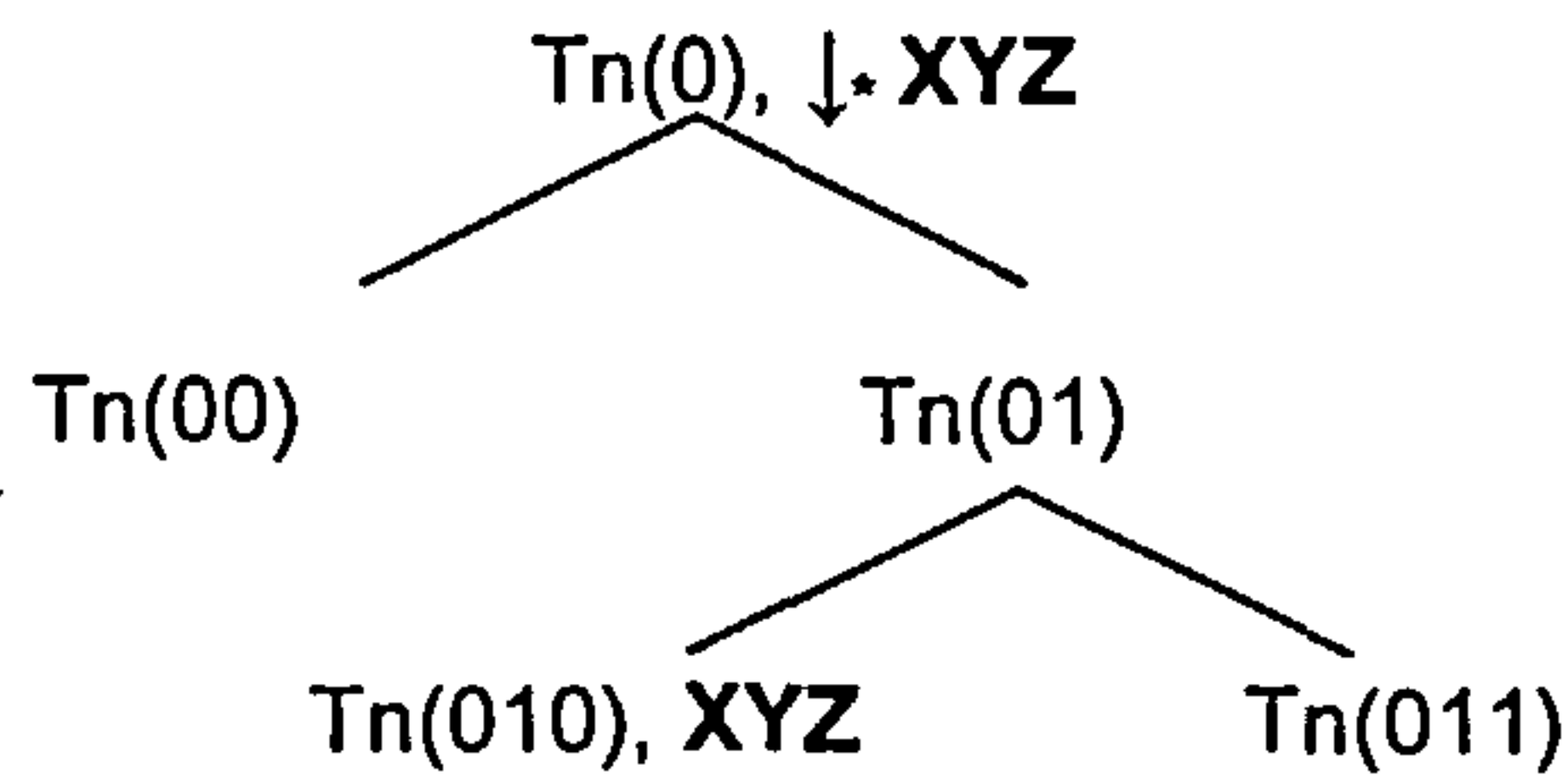
(15)



The processing of most lexical items results in such an annotation appearing in the node description which is a form of ensuring that no superfluous lexical items are ever allowed to be processed. (On the other hand, loss of the ability to contribute such an annotation can be taken to characterise cases where two distinct lexical elements seem to contribute content for the same position on the propositional tree as in e.g. *clitic doubling* in the Romance languages and Greek see, e.g., Anagnostopoulou et al. 1997.)

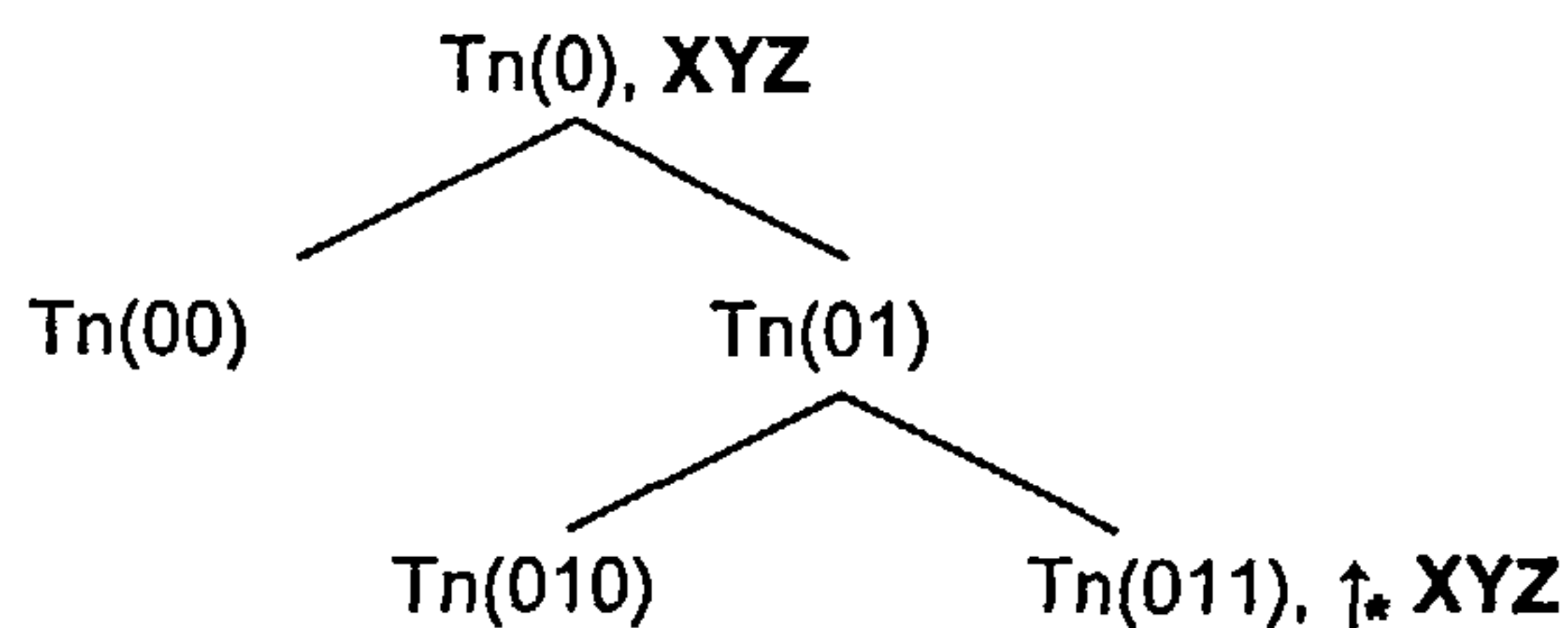
We are now able to include information in the description of a node that concerns other parts of the tree, i.e. we can talk about its daughters, granddaughters or its mother and beyond. However, these modalities do not exhaust the DS descriptive toolbox as we still do not have exactly what we want in terms of expressive capacity. This is because one of the distinctive features of DS is that it models the partiality and enrichment of information holding at successive parsing stages. For this reason the DS apparatus allows for information to be introduced during the parsing process which remains underspecified until a further stage of processing. For example, if we need to indicate that some decoration XYZ appears somewhere above or below the current node but we still do not know where its exact location is, we can express our limited knowledge in the DU language by making use of the Kleene star combined with the up and down arrows. For example we can write things like: \uparrow^*XYZ or \downarrow^*XYZ or even \uparrow^*_iXYZ or \uparrow^*_0XYZ . The Kleene star indicates that there are zero or more steps along the relation denoted by the operator it combines with in order to reach the annotation XYZ. For example in the following, the annotation \downarrow^*XYZ is true at the root node because two steps along the daughter relation bring us to a node where XYZ holds:

(16)

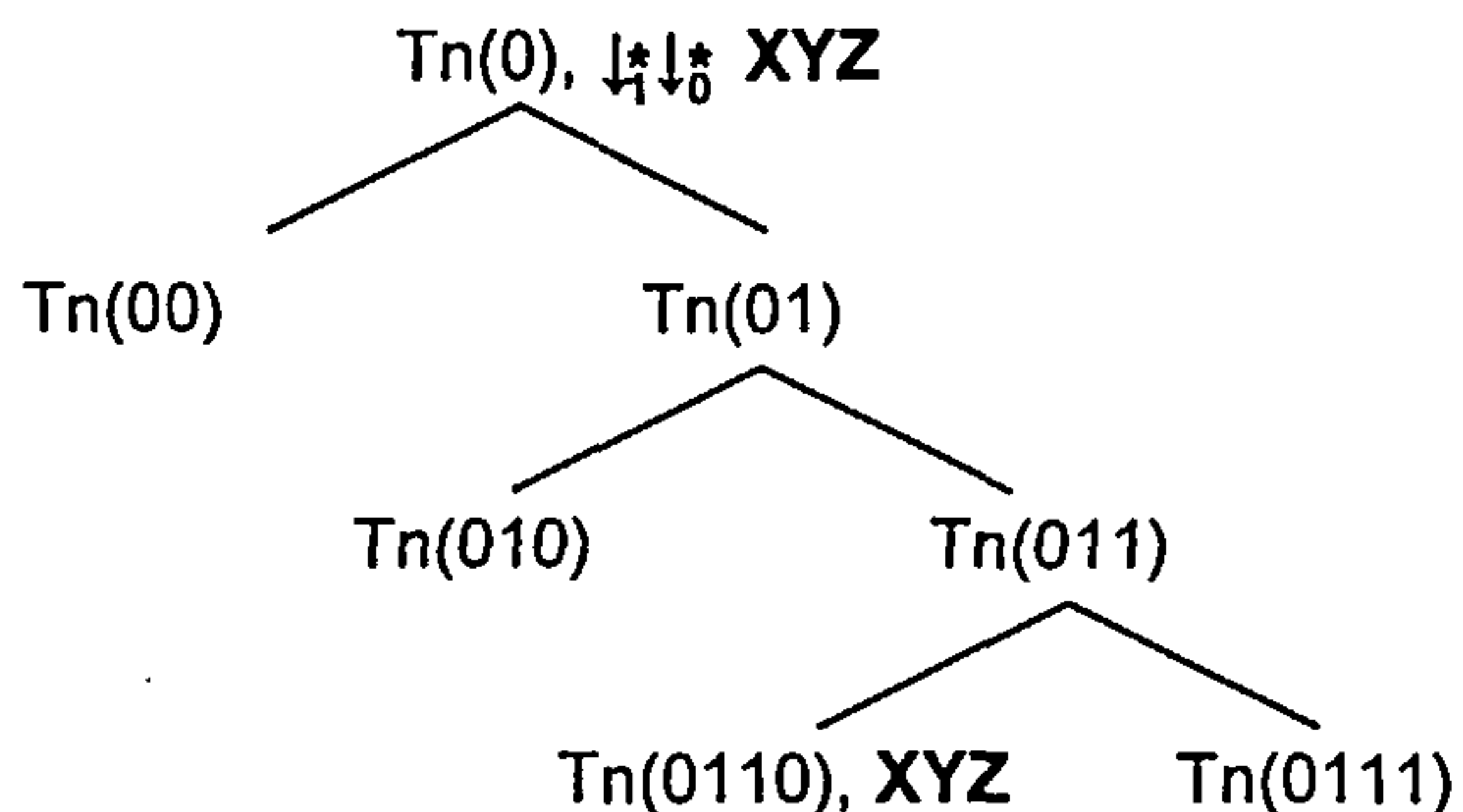


These symbols which combine up and down arrows with the Kleene star are referred to as the *external modalities* in DS (see Kempson et al. 2001: 48-49, 291). In all of the following diagrams the annotations employing the external modalities at each node are satisfied because of the facts holding at other nodes:

(17)



(18)



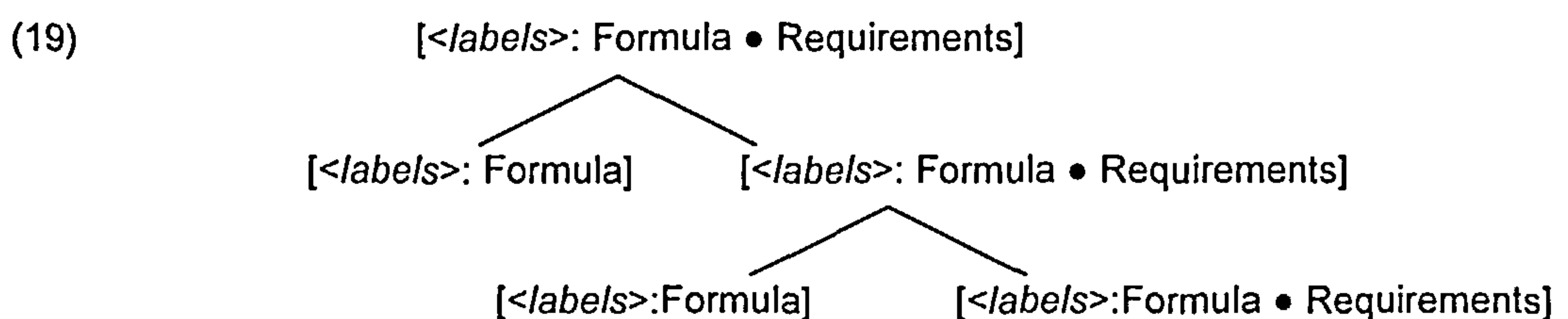
A description in the language DU employing a Kleene star in combination with up or down arrows (e.g. \downarrow^*) is “an underspecified description of a fully specified situation” (Kempson et al. *ibid*: 49), i.e. the node itself in the models satisfying the description has a fully specified position on the tree although the description of this position in the DU language is underspecified. However, as we will see later when we deal with partial trees, we will also require what are called *internal* variants of these modalities by means of the

combination of existential or universal modalities, arrows and the Kleene star (e.g. $\langle \downarrow^* \rangle$). These modalities are used in cases where the exact tree position of a node is left temporarily underspecified, i.e. cases where a node (potentially) has not yet found its proper place on the binary tree. This brings us to another crucial feature of DS: besides descriptions of nodes being underspecified, the DS formalism also allows for the actual tree relations between the nodes on the tree to be partially specified at a particular stage in the processing; additionally, decorations on nodes can be temporarily underspecified and partial too. We turn now to the definitions that implement this partiality.

4. Partiality and Tree-growth

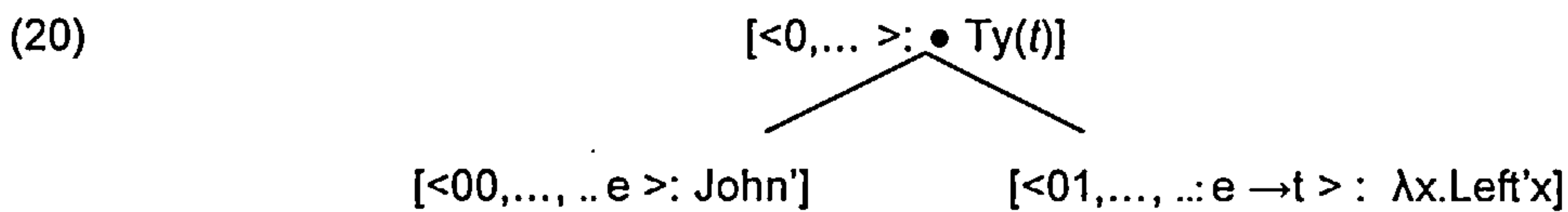
4.a. Requirements

As, in the intermediate stages of the parsing process, DS allows the introduction of underspecified representations, we need to have available the means to ensure that this is just a temporary situation. For this purpose DS employs the concept of a *requirement*, i.e. a decoration on a node which is not yet a fact at this node but must become so at some point, otherwise, the parsing of the string will be declared as unsuccessful. Requirements appear on the trees along with the labels and the formula value. In Kempson et al. (2001), requirements are indicated by means of usual decorations expressed in the language DU following a dot, •, symbol, schematically:

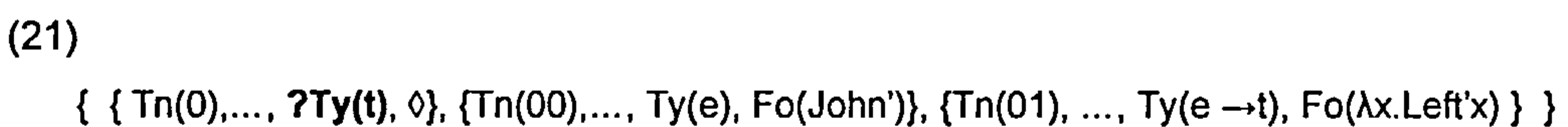


Any type of description of a decoration that has been defined can also appear as a requirement. For example, in (20) below whereas the two daughters

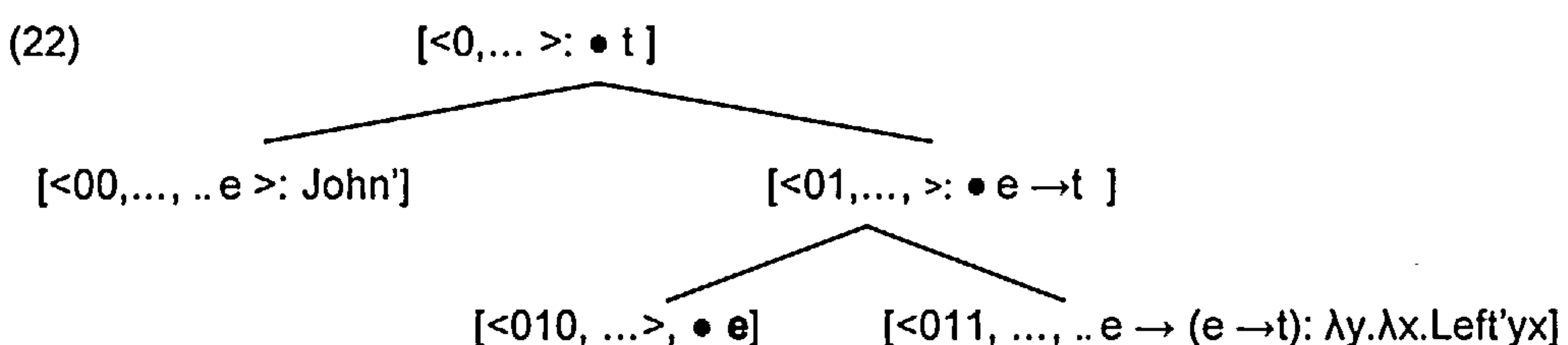
have proper type values, the root node's type is still unspecified and therefore the type label annotation appears after the \bullet symbol:



In the description language DU, a question mark in front of a fact about a node symbolises a *requirement* for that particular fact to become true at the node. The above tree can therefore be described as:



Requirements can be seen as constraints on the well-formedness of the completed structure. A requirement annotation specifies that what follows the question mark must appear as a decoration on the node at some subsequent stage in the parsing process, otherwise, the string will be declared *ungrammatical*. *Grammatical* strings are those for which the parser, after consuming all the lexical input, can produce at least one completed logical form with no requirements outstanding. For the (partial) tree in (20)-(21) above this means that the decoration $\text{Ty}(t)$ must be achieved at the relevant node before the parsing process has been completed. This ensures that a proposition will be the outcome of the parsing of the string “John left”. The subcategorisation frame of a predicate is also taken to be introduced initially by the imposition of requirements for arguments of the appropriate type (e.g. $?\text{Ty}(e)$). So parsing of the verb *left* in a string like “John left Mary” will produce a tree with a requirement at the lower argument node for linguistic input to provide a term of type e :



(23)

$$\{ \{ T_n(0), \dots, ?Ty(t) \}, \{ T_n(00), \dots, Ty(e), Fo(John') \}, \{ T_n(01), \dots, ?Ty(e \rightarrow t) \}, \\ \{ T_n(010), \dots, ?Ty(e), \emptyset \}, \{ T_n(011), \dots, Ty(e \rightarrow (e \rightarrow t)), Fo(\lambda y. \lambda x. Left'yx) \} \}$$

Unless the next step of linguistic input processing provides an object of type e for the satisfaction of the $Ty(e)$ requirement at the pointed node (the object), the parse will be unsuccessful. This is what excludes, for example, the processing of strings like **John left came*.

Requirements combined with the LOFT operators provide a powerful device which can be utilised to impose constraints introduced at one part of the tree but referring to another. For example, one way to deal with the information provided by case specifications on nouns is to analyse them as providing requirements regarding the tree position of the term introduced by processing the noun. The pronoun *he* in a string like *he left* could be taken to introduce a requirement that the representation of whatever male individual is intended by the use of the pronoun appears at a node whose mother is of type t . This can be expressed with the annotation: $?<\uparrow_0>Ty(t)$, contributed by processing of the nominative case marking on the pronoun and appearing at the description of the subject node. It can be loosely read as “the mother node of this node must (eventually) be of type t ”. In contrast, the accusative pronoun *him* in a string like *he left him* can be taken to introduce the requirement: $?<\uparrow_0>Ty(e \rightarrow t)$, read as “the mother of this node must be of type $e \rightarrow t$, i.e., a predicate”, contributed at the tree description by processing of the accusative case morphology. Parsing of a string like **Him left he* will now necessarily result in ungrammaticality because the requirements deposited at the argument nodes by the pronouns’ case morphology will never be able to be satisfied.

Consideration of the contribution of pronouns now brings us to the question of how exactly the content of anaphoric elements like pronominals is integrated into the derivation of a propositional representation, i.e. how their

inherent context-dependent interpretation is achieved as far as DS is concerned. This is the topic of the next section.

4.b. Metavariables

A general distinctive feature of DS is the inclusion of *metavariables* in the node decorations acting as temporary place-holders for proper values. Metavariables are indicated with bold capital letters **U**, **V**, **W**, etc. A metavariable can be used in any type of decoration as a provisional value. In the DU language, any predicate describing a node's formula or label can take a metavariable as its argument, e.g., $Tn(\mathbf{U})$, $Ty(\mathbf{V})$, $Fo(\mathbf{W})$, etc. However, by definition, a metavariable will never count as a proper value because it will be necessarily accompanied by a requirement that will not be satisfied unless a new value is introduced at the node's decorations from a predefined domain of appropriate values. The main domains of appropriate values are: the domain D_{Fo} which contains the terms of the lambda calculus that DS uses as the logical form language, the domain D_{Ty} which contains the logical types of the terms in question, and, similarly for all labels an appropriate domain of values has been determined. In effect then metavariables are not DU object-level variables but substitution sites for other expressions. Context dependent elements like pronouns are then taken to introduce in a node description such metavariables as temporary formula values, e.g. $Fo(\mathbf{U})$. These elements might satisfy a type requirement there but leave the node still essentially incomplete in that the metavariables are still awaiting substitution by an appropriate term.

The job of providing the final values for nodes including metavariables is done by the process of *Substitution* which, in effect, replaces the metavariable with a proper value made available by the context of utterance³⁰. The occurrence of an instance of Substitution is determined by

³⁰ This is metaphorical talk as Substitution introduces a new value but does not actually remove the annotation in the description containing the metavariable.

the presence of an appropriate requirement on a node. This is ensured as follows: The language DU includes variables that have been defined to only range over values from domains like D_{Fo} , D_{Ty} etc. These are indicated in bold font, **x**, **y**, **z** ..., so that they are distinguished from the variables in D_{Fo} , x , y , z , ..., employed by the lambda calculus and which can serve as proper formula values in tree decorations, e.g. $Fo(x)$. A bold variable will be employed in the requirement accompanying a metavariable to mandate that an appropriate value must be found at some point in the parse. For example, the annotation $Fo(\mathbf{U})$ introduced at a node description by processing of the pronoun *he* will be also accompanied by a requirement for a value from D_{Fo} as follows:

$$(24) \quad \{ \dots, Fo(\mathbf{U}), ?\exists \mathbf{x}.Fo(\mathbf{x}), Ty(e) \}$$

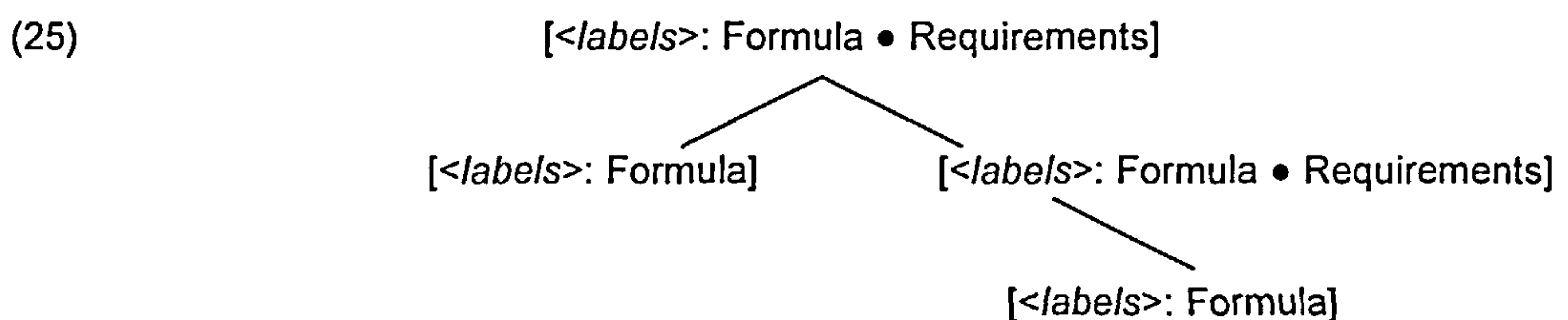
In order to end the parsing process without outstanding requirements an actual term has to replace the metavariable \mathbf{U} because the existential quantifier which binds the bold variable \mathbf{x} can only range over elements of D_{Fo} which includes all objects of type e in the logical vocabulary except metavariables like \mathbf{U} ; so the annotation $Fo(\mathbf{U})$ does not satisfy the requirement $? \exists \mathbf{x}.Fo(\mathbf{x})$, whereas $Fo(John')$ does because the value *John* is included in D_{Fo} . A further distinguished set of metavariables are those of the form $\mathbf{WH}_1, \mathbf{WH}_2, \dots, \mathbf{WH}_n$, which are assigned as the value projected by the processing of *wh*-expressions in *wh*-questions. These metavariables are exceptional however in that they are retained in the formula that results after processing a string.

We now turn to other forms of partiality, namely underspecified tree relations and underspecified decorations on a node.

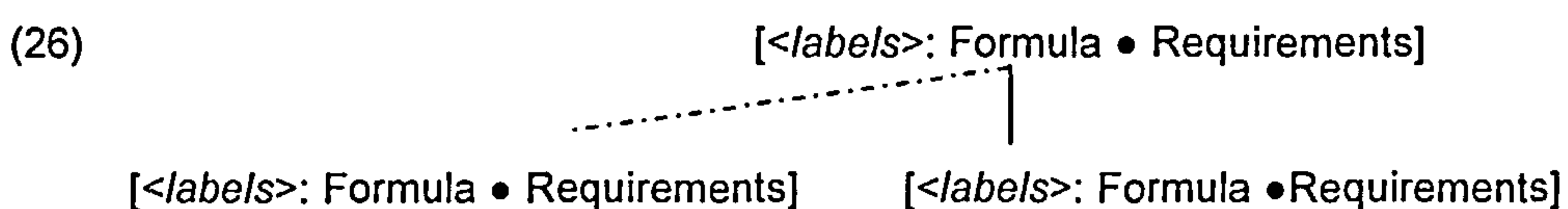
4.c. Underspecified tree relations

Since DS models the gradual construction of a logical form it has to provide the means for accomplishing two objectives: (a) describing stages in the

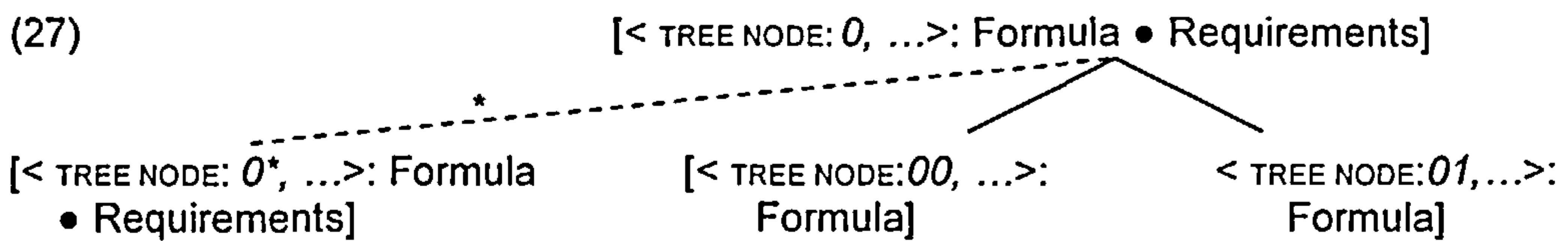
construction process and (b) define procedures that licence the transition from one stage to the other. We will take up the second of those tasks in the next section. The first is catered for in DS by manipulating tree descriptions which take as models *partial* objects/trees. The latter are trees that have some information missing from them: The information can be structural, e.g. we can have a tree as in (25) below which still misses one branch to be a complete binary tree:



Alternatively, we could have a situation schematically presented in (26) below where the root node dominates two other nodes and of those we know that one is its daughter but we still do not know whether this daughter is a functor or argument node; in addition the second dominated node, indicated with the dotted line connector, is completely underspecified with respect to the root in that we only know that it will be dominated by it but not yet its exact position on this tree:

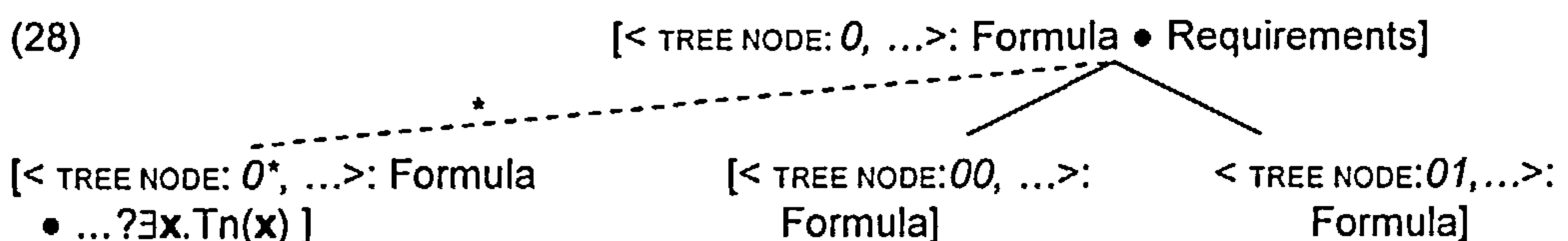


To cater for situations like those, besides the notions of immediate dominance, left daughter, right daughter, etc. DS also introduces a new relation between nodes: the relation of a node being dominated by another node but with not yet having completely specified how many steps along the dominance relation intervene between the two nodes. On a tree diagram this is usually presented by having a branch connected by a dashed line with the node that dominates it (but bear in mind that the node's position is not really on the left or the right of the tree in any actual sense):



The relation shown with the dashed line stands for the reflexive transitive closure of the dominance relation. We could call this relation the $*$ -relation (star relation) since it is based on the Kleene star definition of indicating zero or more steps along the dominance relation. In other words, the $*$ -relation holding between two nodes A and B implies that either A and B are one and the same node or that node B is somewhere on the tree dominated by node A.

In the language DU in order to describe trees with nodes related in such a way we employ the LOFT modalities in the following manner: if, while at some node currently under development, we need to indicate that some decoration XYZ appears at some node which bears the $*$ -relation to the current node we can attach the operator $\langle \downarrow^* \rangle$ in front of the annotation XYZ to construct the annotation: $\langle \downarrow^* \rangle \text{XYZ}$, read as “there is a node which is $*$ -related to this node and XYZ holds there”. To indicate that the current node is related by the $*$ -relation to another node with the decoration XYZ we annotate it with: $\langle \uparrow^* \rangle \text{XYZ}$. Nodes which are introduced as bearing the $*$ -relation to other nodes are called *unfixed nodes* since they bear a provisional tree address that requires updating to become a proper tree position. This need for update is explicitly indicated by recording the requirement $\exists x. \text{Tn}(x)$ along with the introduction of the unfixed node:

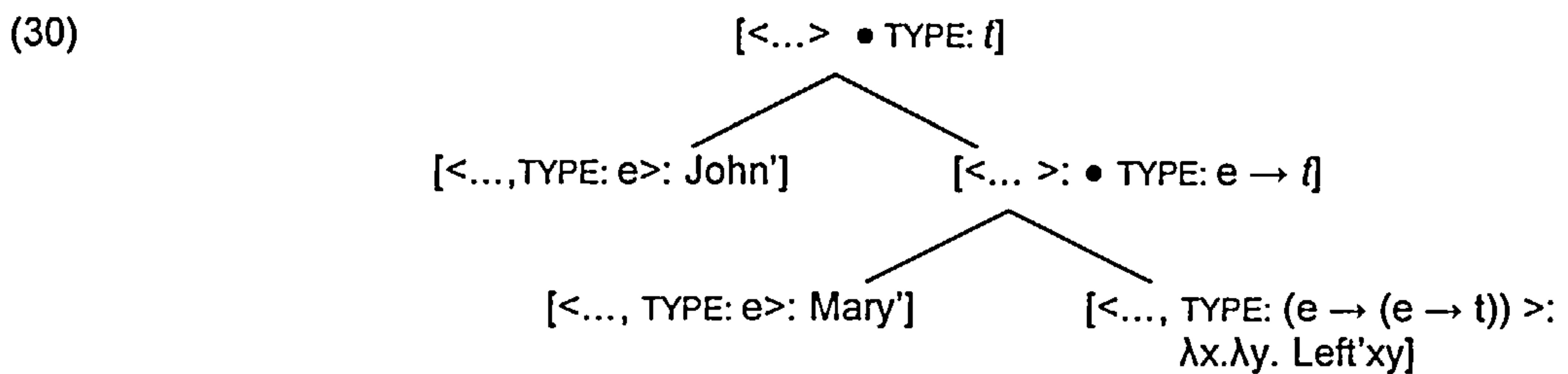


And the following is a true description of the above schematic tree employing the LOFT operators:

$$(29) \{ \{Tn(0), \dots, <\downarrow^*>? \exists x.Fo(x), \dots\}, \{<\uparrow_*> Tn(0), ? \exists x.Tn(x), \dots\}, \\ \{Tn(00), <\uparrow_0><\downarrow^*>? \exists x.Tn(x), \dots\}, \{Tn(01), <\uparrow_1><\downarrow^*>? \exists x.Tn(x), \dots\} \}$$

4.d. Underspecified decorations

Trees can also be regarded as partial in the course of the parsing process because of incomplete decorations on their nodes. In (30) below neither formula nor type values are still available for the internal (non-terminal) nodes. As we said, such incompleteness is usually indicated with the missing elements recorded as requirements, i.e. constraints to be satisfied as the tree and its decorations further develop:



As for DS it is essential to be able to describe such partial objects and their update, a tree development process (“tree growth”) is defined. It involves a mapping from less to more specified tree descriptions in the language DU. The process always starts with the most minimal of tree descriptions, a one-node tree description called the *Axiom*:

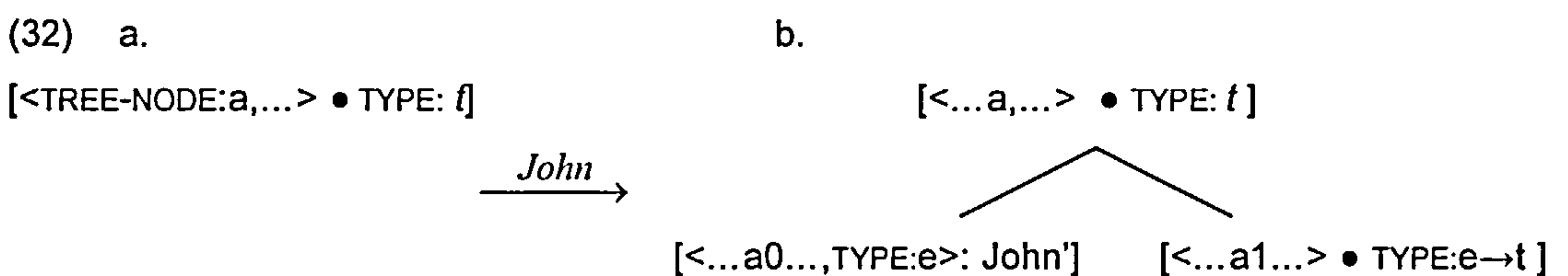
$$(31) \quad \{ \{Tn(a), ?Ty(t), \diamond\} \}$$

The definition of the *Axiom* above sets out the ultimate aim of the parser according to DS, which is to evolve a completed decorated tree structure of type t ($Ty(t)$). When this goal has been achieved the requirement, $?Ty(t)$, will be satisfied and the parsing process will end successfully. On the way to the

satisfaction of this requirement the processes defined by DS license the mapping of partial incomplete trees to more complete ones as more and more linguistic input is processed. The address on the node, $T_n(a)$, is a provisional specification which will be fully determined when the rest of the tree has been completed and it has been determined whether or not this is indeed the description of the root node (this provision is made because, for instance, in strictly head-final languages there is always uncertainty as to whether an initially constructed propositional tree will eventually be embedded in a larger structure or not).

4.e. An example of tree-growth

The parsing process is formulated by means of transformations of DU language descriptions to new ones under the influence of general rules and the consuming of linguistic input. The descriptions manipulated correspond to partial trees which become more and more specified as the parsing process unfolds. We will present these manipulations in the next section. As an example of how the actual models of these descriptions, the trees themselves, evolve consider the following simplified stages of parsing the string *John left Mary*:

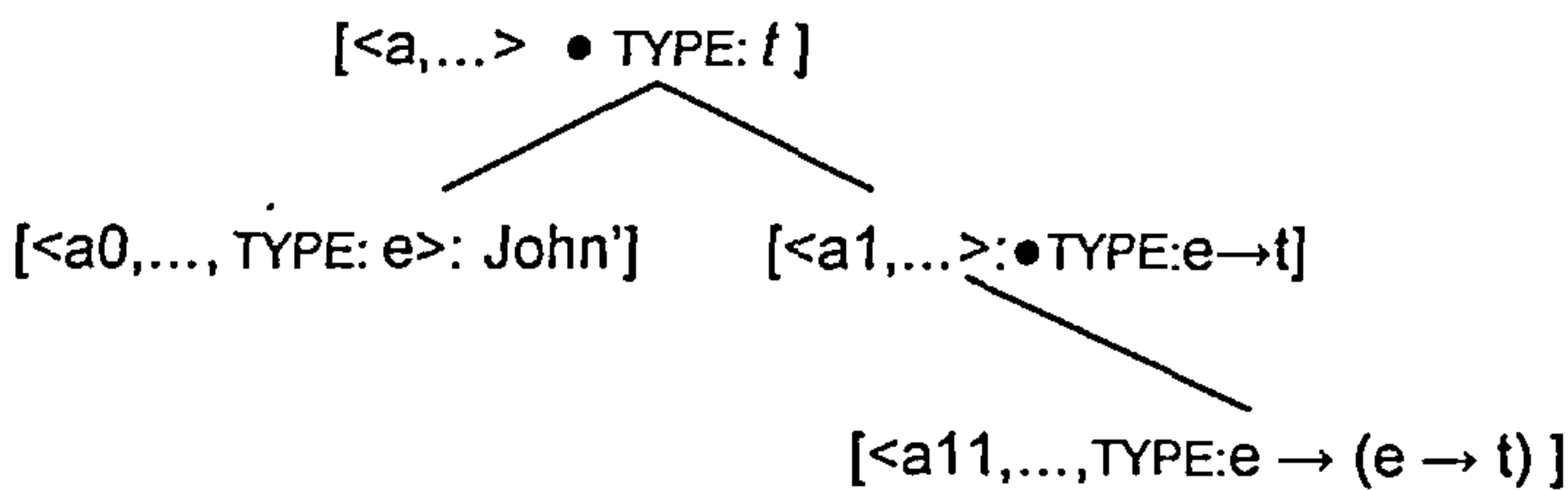


The first minimal tree in (32) is what the *Axiom* describes. After the processing of the word *John* the second tree, (32), is developed which bears an argument node with the term *John'* as its formula value. The way is now open for the parsing of a predicate (type $e \rightarrow t$) that will be provided by processing the word *left*. In (33) below the effect of processing that word is displayed: the tree is expanded with one more node, (33), an annotation of a

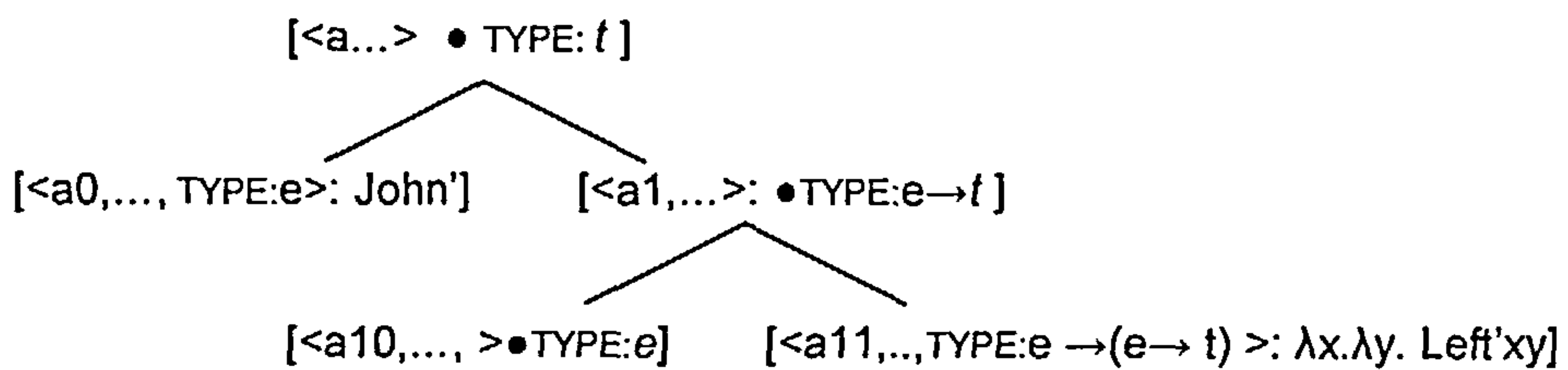
predicate term *left'* is provided and the way for parsing *Mary* is prepared by introducing the requirement for another type *e* argument node, (33):

(33) $\xrightarrow{\text{left}}$

a.

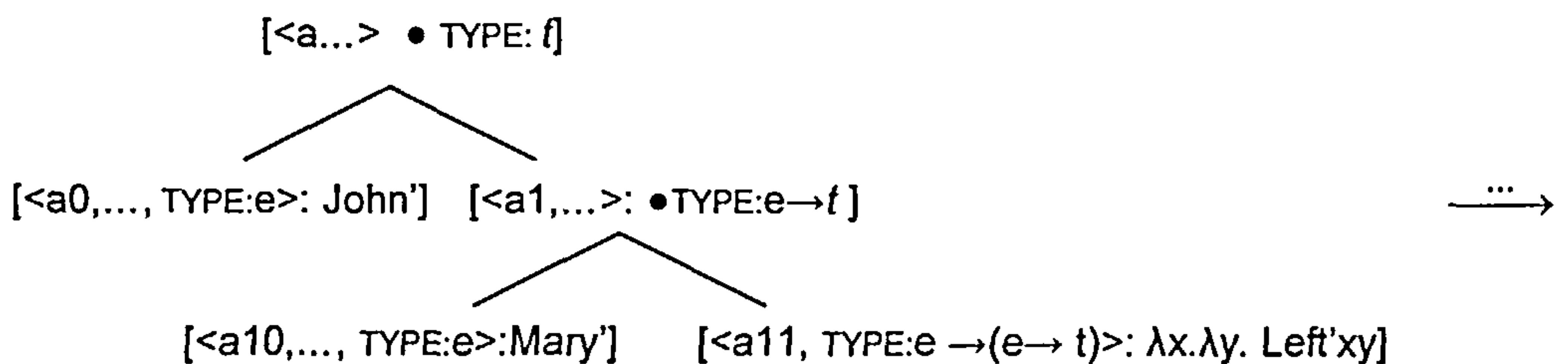


b.



Processing of *Mary* completes the contribution of lexical input:

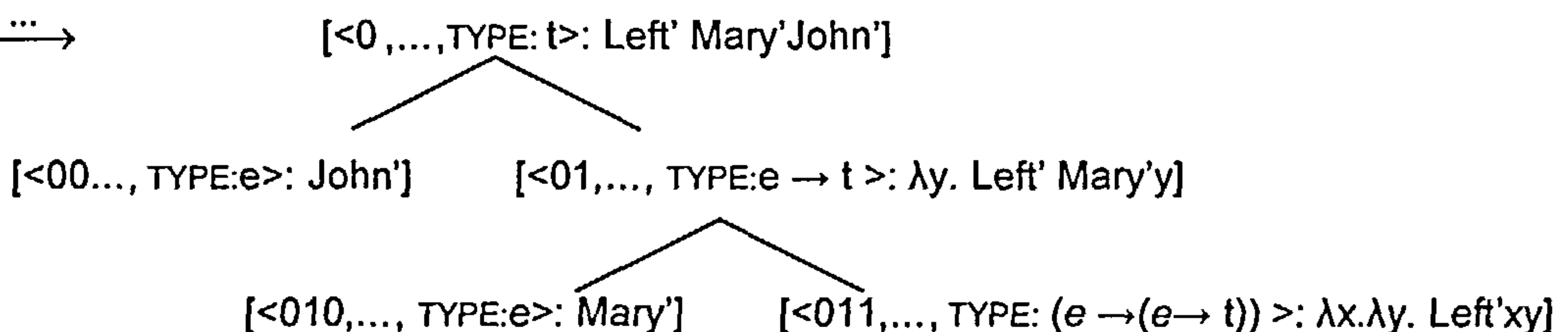
(34) $\xrightarrow{\text{Mary}}$



After several intermediate steps which will be presented in detail below the parsing is successful since a type *t* term is derived at the root node of the tree without any requirements outstanding:

(35)

$\xrightarrow{\dots}$



As we said the tree growth process shown here in terms of a sequence of decorated trees is in fact executed through the manipulation of descriptions expressed in the DU language. We turn to a presentation of those next.

5. Procedural structure

The tree growth displayed above is induced and controlled by two interacting mechanisms provided by the DS formalism:

- (a) *lexical procedures* associated with the *words* in the parsed string
- (b) *general computational procedures* that map one partial tree to another if certain conditions are fulfilled.

The linguistic string under processing is seen in DS as providing a series of triggers for instructions that will be executed in a left-to-right sequence according to each word's linear position. Interspersed among those instructions general computational rules might be invoked which license transitions from one partial tree to another without the need to consume any lexical input. Although the mode of presentation of these two interacting components is slightly different, they are both rules of exactly the same type, i.e. mappings from one partial tree description to another involving actions taken by the parser.

Lexical rules which are stored in the lexicon of a particular language are presented according to the following general format:

(36)	<i>word form</i>	
IF	α, \diamond	(if decoration α appears on the node bearing the pointer)
THEN	make (x),	(then make x , and/or
	go (x),	go to x , and/or
	put (x), ...	put decoration x ...)
ELSE	abort	(otherwise, i.e. if decoration α does not hold, abort parsing)

The rule as defined above first checks whether some specification holds at the node description where the pointer resides (the **IF** clause, the condition or trigger). If this is the case then it invokes *actions* like *make*, *put*, and *go* which introduce structure and decorations and move the pointer around the tree. Computational rules are also instructions of the same type but they are executed without the need of processing lexical input. They consist of the same type of actions as the lexical rules only this time they are presented in a condensed format. The condition for the rule's application is shown as the input tree (see below Tree Description 1), equivalent to the **IF** clause above in the lexical rule. By application of the rule the input is transformed to the output, shown below the line (Tree Description 2), equivalent to a **THEN** clause:

(37) Tree Description 1
 Tree Description 2

Since such rules are not triggered by the processing of linguistic input their application is always optional. Interspersed among applications of these and lexical rules are *pragmatic actions* which manipulate the logical form in conjunction with other externally provided information in order to derive contextual effects. Pragmatic actions model processes external to the computational/lexical system. In DS such actions are taken mainly to fulfil the role of updating the values contributed by underspecified expressions. As DS does not model the actual processes of disambiguation and selection of an interpretation among the many possible ones in context we will have nothing more to say as to how exactly these processes operate besides directing the reader to pragmatic approaches like *Relevance Theory* (see e.g. Sperber & Wilson 1986/1995). However it is the burden of DS to provide the constraints which restrict and direct the operations of the pragmatic component. These constraints are articulated by means of the interaction of the lexical actions provided by the particular words in a natural language and the rule system that is presented immediately below.

5.a. Transition Rules

As we have repeatedly said, the goal of the parsing process is to construct a binary tree the top node of which is decorated by a formula of type t having consumed all the linguistic input provided by the sentence. In order to start the process off and to progress from one stage to the next, *transition rules* license steps of computation to take place and transform input tree descriptions to new ones. The core rules of this type are those of *Introduction* and *Prediction* and *Completion* and *Elimination* (for formal definition of the rules see Kempson et al. 2001: 81, 307-325). The first two expand the node where the pointer resides by introducing new nodes as its daughters. Completion and Elimination are the rules which finish off the compilation of the information on the tree after all the requisite input has accumulated on the relevant nodes. Complementary to the actions of these rules are also two more: the rule of *Anticipation* which moves the pointer from mother to daughter if there is a need to satisfy a requirement there and the rule of *Thinning* which gets rid of the annotations of requirements that have been satisfied. We shall now see these rules in some more detail.

5.a.1. Introduction

The rule of *Introduction* works by in effect breaking down a general goal into two distinct sub-goals. The rule applies at a node description where there a requirement for a type value and this type value could be derived by performing Modus Ponens on two other types each occupying one of the node's daughters. Introduction is defined so as to generate requirements on the node itself; these requirements force the node in question to subsequently acquire two daughters with the type values needed. The eventual fulfilment of these requirements will lead to the satisfaction of the type requirement on the node itself:

(38) *Introduction*

$$\frac{\{...\{...\text{?Ty}(Y)...\}, \diamond\}...\}}{\{...\{...\text{?Ty}(Y), \text{?} < \downarrow_0 > \text{Ty}(X), \text{?} < \downarrow_1 > \text{Ty}(X \rightarrow Y) \dots, \diamond\}, \dots\}}$$

For example, one way to initiate the parsing of a string in English is to assume that the rule of Introduction applies on the *Axiom*, the description of a node which just contains a requirement for a type t value. Introduction will then generate the appropriate requirements for one daughter with a type e value and another with a type $e \rightarrow t$ value:

$$(39) \quad \{ \{ Tn(a), ?Ty(t), \dots, \Diamond \} \} \xrightarrow{\text{Introduction}} \{ \{ \dots Tn(a), ?Ty(t), ?\langle \downarrow_0 \rangle Ty(e), ?\langle \downarrow_1 \rangle Ty(e \rightarrow t) \dots, \Diamond \} \}$$

5.a.2. Prediction

The Introduction rule is usually paired up with a subsequent application of the rule of *Prediction* since Introduction does not actually itself build the nodes that are expected to satisfy the requirements it imposes. The node-building is the job of the Prediction rule. The latter applies when there are modal requirements at a node, i.e. requirements for information to appear at its daughters but these daughters do not still exist. The effect of an application of Prediction is to construct these nodes:

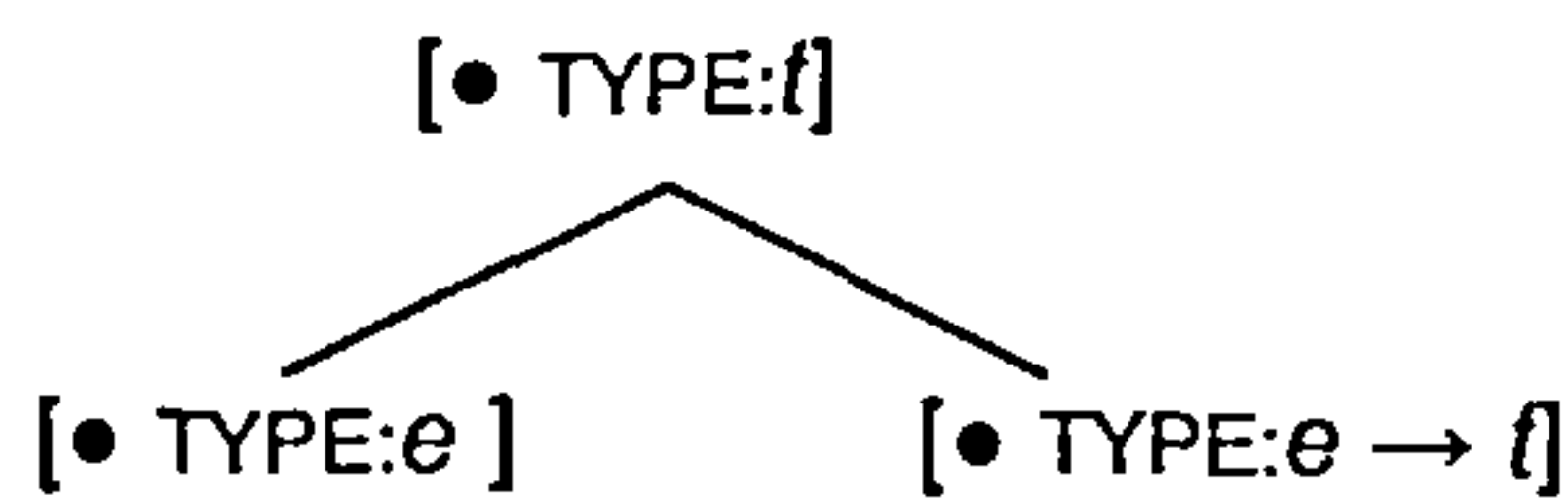
$$(40) \quad \frac{\{ \dots Tn(n), \dots ?\langle \downarrow_0 \rangle X, ?\langle \downarrow_1 \rangle Y, \Diamond \}}{\{ \{ Tn(n), \dots ?\langle \downarrow_0 \rangle X, ?\langle \downarrow_1 \rangle Y \}, \{ \langle \uparrow_0 \rangle Tn(n), ?X, \Diamond \}, \{ \langle \uparrow_1 \rangle Tn(n), ?Y \} \}}$$

Typically Prediction will also move the pointer to the argument daughter just introduced. Continuing the example in (39) above, the enriched tree description after Introduction can now be extended further by introducing the daughter nodes in the description by an application of Prediction:

$$(41) \quad \{ \{ Tn(a), ?Ty(t), \Diamond \} \} \xrightarrow{\text{Introduction}} \{ Tn(a), ?Ty(t), ?\langle \downarrow_0 \rangle Ty(e), ?\langle \downarrow_1 \rangle Ty(e \rightarrow t), \Diamond \} \xrightarrow{\text{Prediction}} \{ \{ Tn(a), Tn(a), ?\langle \downarrow_0 \rangle Ty(e), ?\langle \downarrow_1 \rangle Ty(e \rightarrow t) \}, \{ \langle \uparrow_0 \rangle Tn(a), ?Ty(e), \Diamond \}, \{ \langle \uparrow_1 \rangle Tn(a), ?Ty(e \rightarrow t) \} \}$$

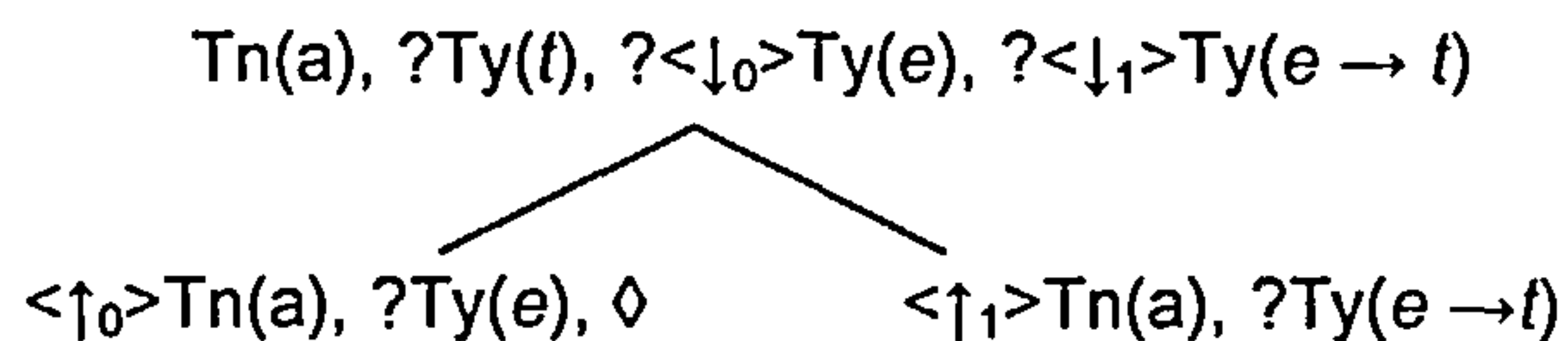
The tree that this description corresponds to is as follows:

(42)

**5.a.3.*****Digression regarding diagrams***

The DS parsing framework is defined over tree descriptions (see e.g. Kempson et al. 2001). Models for these descriptions are provided by a set of (partial) trees decorated by feature structures. Since for reasons of space it is difficult to sustain the visual presentation of both models and descriptions, for convenience from now on we will resort to representations of descriptions that mimic visually their models. So it must be kept in mind that a graph like the one shown in (43) below stands in fact for the third part of the description in (41) although for illustration purposes it is presented in a format that is reminiscent of its model (42) (the simplification can be seen as taking positions of nodes and tree branches to stand in place of the set { } brackets used in the actual node and tree descriptions):

(43)



This visual simplification does not affect the substance of the presentation because the descriptions are in some precise sense isomorphic to their models (see Kempson et al: 53-54).

We now move to rules that instead of unfolding the tree perform computations on the values derived at each node.

5.a.4.***Completion***

This rule takes as its input a tree description with a node containing the pointer. This node will also bear information which is appropriate in order for its mother to satisfy some of its requirements. The output of the rule is a new

tree description such that the pointer has moved to that mother node and the relevant information about the daughter has been recorded there³¹:

(44) **Completion**

$$\frac{\{...\{Tn(n), \dots\}, \{<\uparrow_i>Tn(n), \dots, Ty(X), \dots, \diamond\}\}}{\{...\{Tn(n), \dots, <\downarrow_i>Ty(X), \dots, \diamond\}, \{<\uparrow_i>Tn(n), \dots, Ty(X), \dots, \}\}} \\ \text{where } i \in \{0, 1, *\}$$

For example, consider the following tree (description) which has been constructed after the parsing of the string *John left*:

(45)

$$\begin{array}{c} Tn(a), ?Ty(t), <\downarrow_0>Ty(e), ?<\downarrow_1>Ty(e \rightarrow t) \\ \swarrow \quad \searrow \\ <\uparrow_0>Tn(a), Ty(e), Fo(John') \quad <\uparrow_1>Tn(a), Ty(e \rightarrow t), Fo(\lambda x. Left'x), \diamond \end{array}$$

Application of the Completion rule to this tree description allows us to move the pointer from the type $e \rightarrow t$ node to its mother and introduce there the information that the daughter is indeed of type $e \rightarrow t$, thus satisfying the requirement $?<\downarrow_1>Ty(e \rightarrow t)$:

(46)

$$\begin{array}{c} Tn(a), ?Ty(t), ?<\downarrow_1>Ty(e \rightarrow t), <\downarrow_1>Ty(e \rightarrow t), <\downarrow_0>Ty(e), \diamond \\ \swarrow \quad \searrow \\ <\uparrow_0>Tn(a), Fo(John') \quad <\uparrow_1>Tn(a), Ty(e \rightarrow t), Fo(\lambda x. Left'x) \end{array}$$

The only thing that remains to be done for the above tree to be completed is the satisfaction of its type t requirement. This can be accomplished by the rule of Elimination which is presented below.

³¹ In Kempson et al. (2001) this rule is stated in a more general form which covers the potential to record information about the daughter nodes for any type of information that might be needed at the mother. Here following Cann et al. (2005) we will simplify the presentation by showing only a specific instance of the rule with respect to types. The same comment applies to the rules of Prediction and Elimination.

5.a.5. Elimination

When the rule of Elimination applies at a node description it achieves two things: (a) it deduces the required type for the node by applying Modus Ponens over the type labels of its daughters (now recorded on the node itself by Completion), and, (b) it performs function application over the formula values at the daughters and records the result at the mother as its own formula value. The rule also includes a condition that it can only be performed if there are no requirements left at the node's daughters:

(47) Elimination

$$\frac{\{...\{ \langle \downarrow_0 \rangle (\text{Fo}(a), \text{Ty}(X)), \langle \downarrow_1 \rangle (\text{Fo}(b), \text{Ty}(X \rightarrow Y)), \dots, \diamond \} \}}{\{...\{ \text{Fo}(b(a)), \text{Ty}(Y), \langle \downarrow_0 \rangle (\text{Fo}(a), \text{Ty}(X)), \langle \downarrow_1 \rangle (\text{Fo}(b), \text{Ty}(X \rightarrow Y)), \dots, \diamond \} \}}$$

Condition: $\langle \downarrow_i \rangle ?\phi$ does not hold where $i \in \{1, 0\}$

Continuing the example in (46) above, the effect of Elimination on the root node can be shown as follows:

$$(48) \quad \begin{array}{c} \text{Tn}(a), ?\text{Ty}(t), \text{Ty}(t), \text{Fo}(\text{Left}'\text{John}'), \langle \downarrow_1 \rangle \text{Ty}(e \rightarrow t), \langle \downarrow_0 \rangle \text{Ty}(e) \diamond \\ \swarrow \quad \searrow \\ \langle \uparrow_0 \rangle \text{Tn}(a), \text{Fo}(\text{John}') \quad \langle \uparrow_1 \rangle \text{Tn}(a), \text{Ty}(e \rightarrow t), \text{Fo}(\lambda x. \text{Left}'x) \end{array}$$

Application of Elimination at the root node performs Modus Ponens on the types of the function and argument daughter and records the resulting type t as the type of the root. In addition it performs application of the function $\lambda x. \text{Left}'x$ at the functor daughter on the argument John' at the other daughter and deposits the resulting proposition $\text{Left}'\text{John}'$ at the root.

5.a.6. Thinning

As can be seen on the tree above we now have a requirement at the root $?\text{Ty}(t)$ and also an annotation $\text{Ty}(t)$ satisfying it. Therefore we now also need a rule that will allow us to remove the requirement from the description. This is the job of the following rule of *Thinning*. Thinning simply applies at a node when a requirement for some fact appears there as well as an indication that

the fact has become indeed the case. It has the effect of just deleting the satisfied requirement:

(49) **Thinning**

$$\frac{\{..., X, ..., ?X, ..., \diamond\}}{\{..., X, ..., \diamond\}}$$

This is a necessary action that must be performed, otherwise the parsing process will not be successful with requirements still remaining on the tree. We will also assume here that application of this rule is obligatory as soon as some requirement has been satisfied:

$$(50) \quad \begin{array}{c} \text{Tn}(a), ?\text{Ty}(f), \text{Ty}(f), \text{Fo}(\text{Left}'\text{John}'), <\downarrow_1> \text{Ty}(e \rightarrow f), \diamond \\ \swarrow \quad \searrow \\ <\uparrow_0> \text{Tn}(a), \text{Fo}(\text{John}') \quad <\uparrow_1> \text{Tn}(a), \text{Ty}(e \rightarrow f), \text{Fo}(\lambda x. \text{Left}'x) \end{array}$$

5.a.7. **Anticipation**

The rule of Anticipation is needed just for pointer management purposes. The rule applies to enable the pointer to move down from a node under development to one of its daughters that has an outstanding requirement:

(51) **Anticipation**

$$\frac{\{\text{Tn}(n), ..., \diamond\}, \{<\uparrow> \text{Tn}(n), ..., ?X, ...\}}{\{\text{Tn}(n), ..., \{<\uparrow> \text{Tn}(n), ..., ?X, ..., \diamond\}$$

5.a.8. **Star Adjunction and Merge**

The rules of *Introduction* and *Prediction* construct the functor and argument daughters of (typically) the root node. Another introductory rule, the rule of *Star(*)-Adjunction*, is responsible for introducing instead a node which is underspecified with respect to the root node, what we called earlier an *unfixed* node. The only information about this node's address is that it is dominated by the root, otherwise, the node could eventually end up at any position inside the local propositional tree as long as a type annotation is matched. The rule also moves the pointer to the newly constructed node and imposes as

requirements the immediate anticipation of lexical input of the appropriate type (here $?Ty(e)$) and the obligatory search for some fixed tree address ($? \exists x.Tn(x)$):

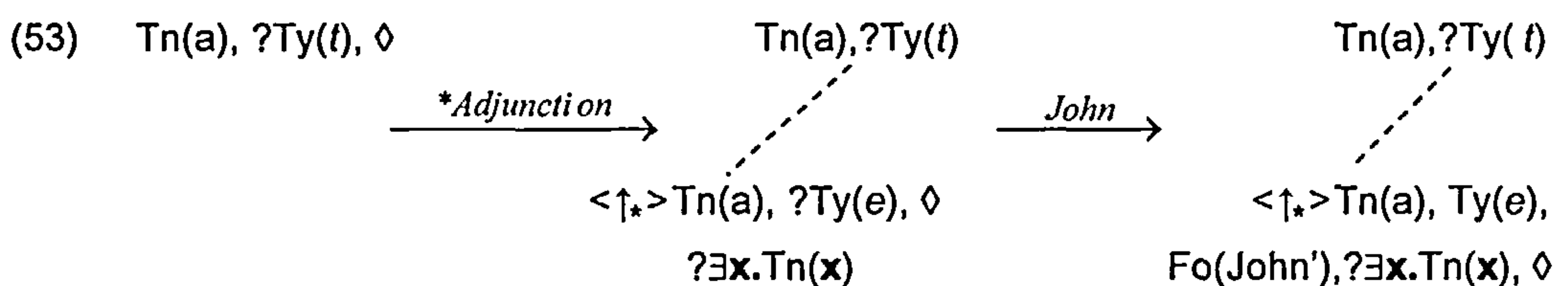
(52) *** Adjunction**

$$\frac{\{ \{Tn(a), \dots ?Ty(t), \diamond \} \}}{\{ \{Tn(a), \dots ?Ty(t)\}, \{ \langle \uparrow_* \rangle Tn(a), \dots, ? \exists x.Tn(x), ?Ty(e), \diamond \} \}}$$

This rule is usually employed in order to allow the processing of fronted constituents such as question words, focalised elements etc. It is representative of a set of DS devices which license the introduction of content with an as yet unspecified role in the structure to be projected. As an illustration of its operation consider below the parsing steps involved when processing the string *John, Mary likes*.

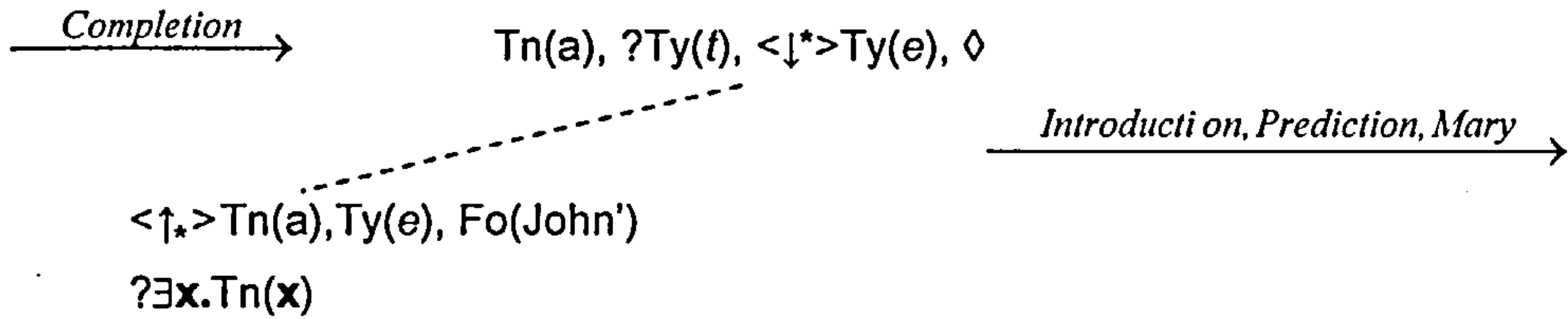
5.a.8.a. *An example involving Star Adjunction*

After the *Axiom* is introduced the rule of *Adjunction applies and an unfixed node is constructed to which the pointer moves. Since the new node requires input of type e, the word *John* can be processed to provide this input:

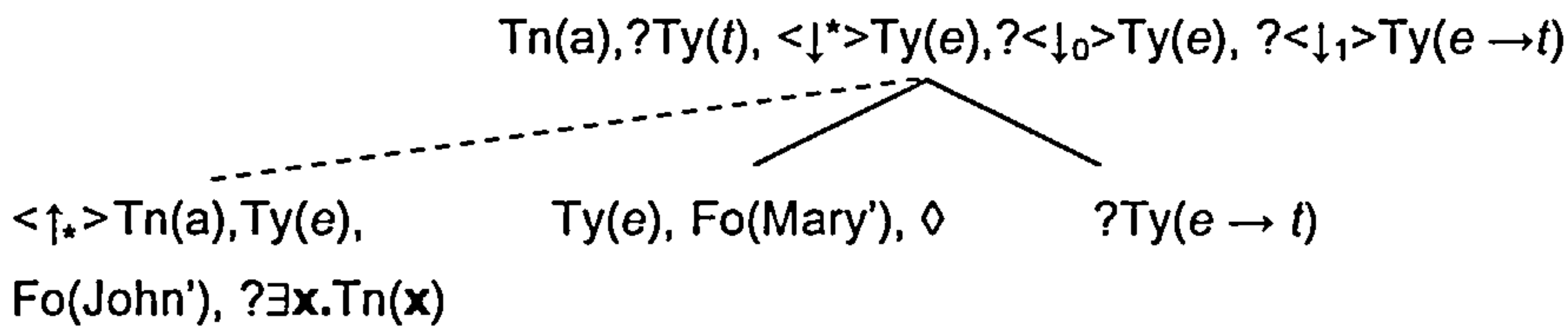


The rule of Completion now moves the pointer up to the root node and the rules of Introduction and Prediction construct the subject and predicate nodes. Input in the form of the word *Mary* provides a type e annotation at the subject node:

(54)

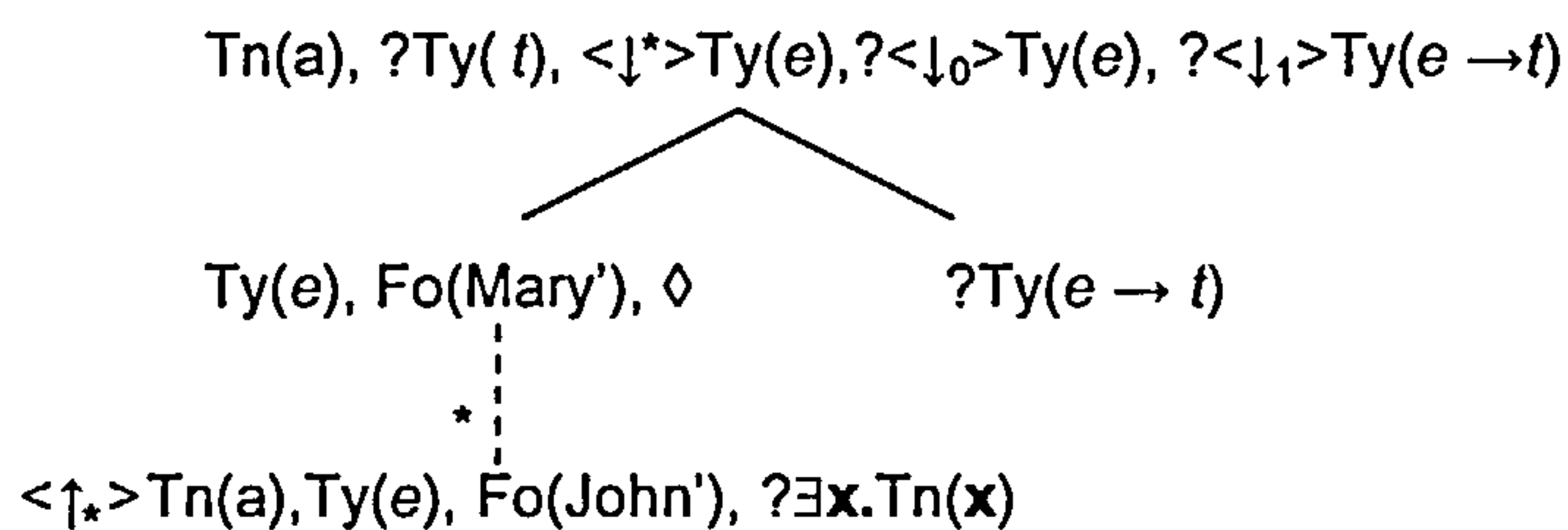


(55)

**5.a.9.****The Normal Form Constraint**

According to the formal description of the DS model as defined in Kempson et al. 2001, the trees that satisfy the DU descriptions are always in *Normal Form*. What this means is that any nodes bearing some underspecified relation, e.g. the relation introduced by **Adjunction*, to some other node will appear as low as possible on the tree. So the tree shown in (55) is not actually well-formed as the unfixed node should either have merged with one of the other nodes or hang below the node bearing the pointer:

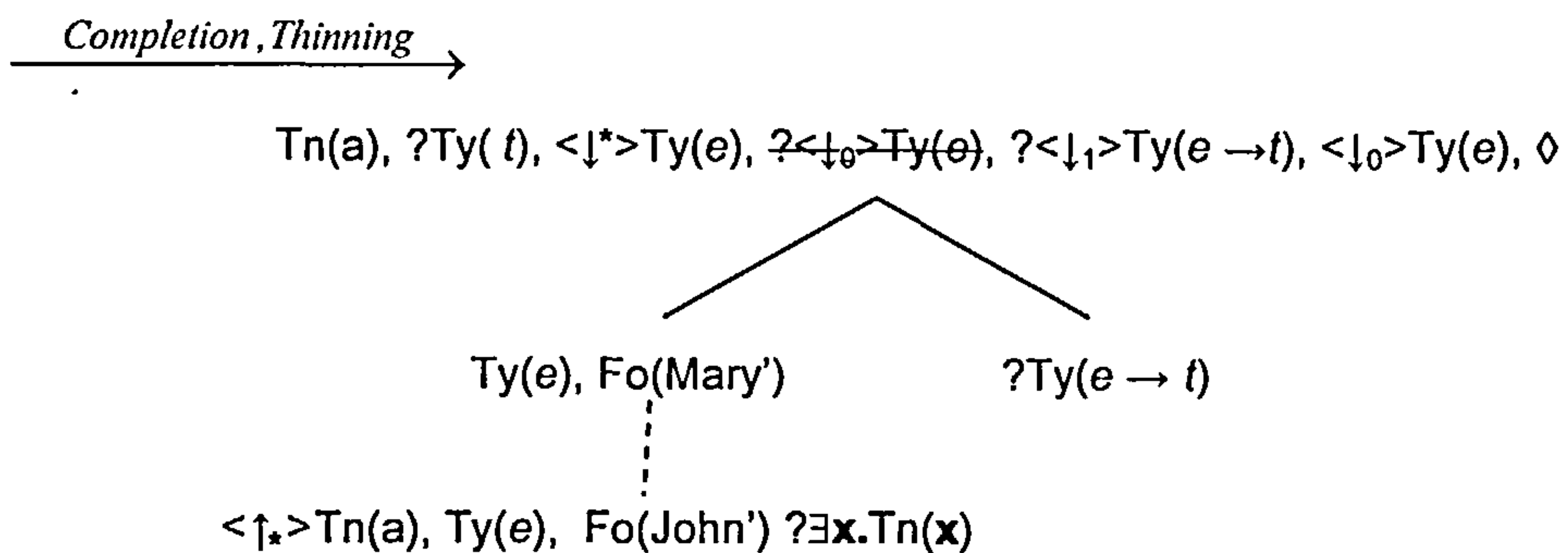
(56)



Note that on the tree above, which is indeed in Normal Form, the decoration $\langle \uparrow_* \rangle Tn(a)$ on the unfixed node is still satisfied. This is because the underspecified $*$ -relation does not exclude any tree position as long the node is still dominated by the root $Tn(a)$.

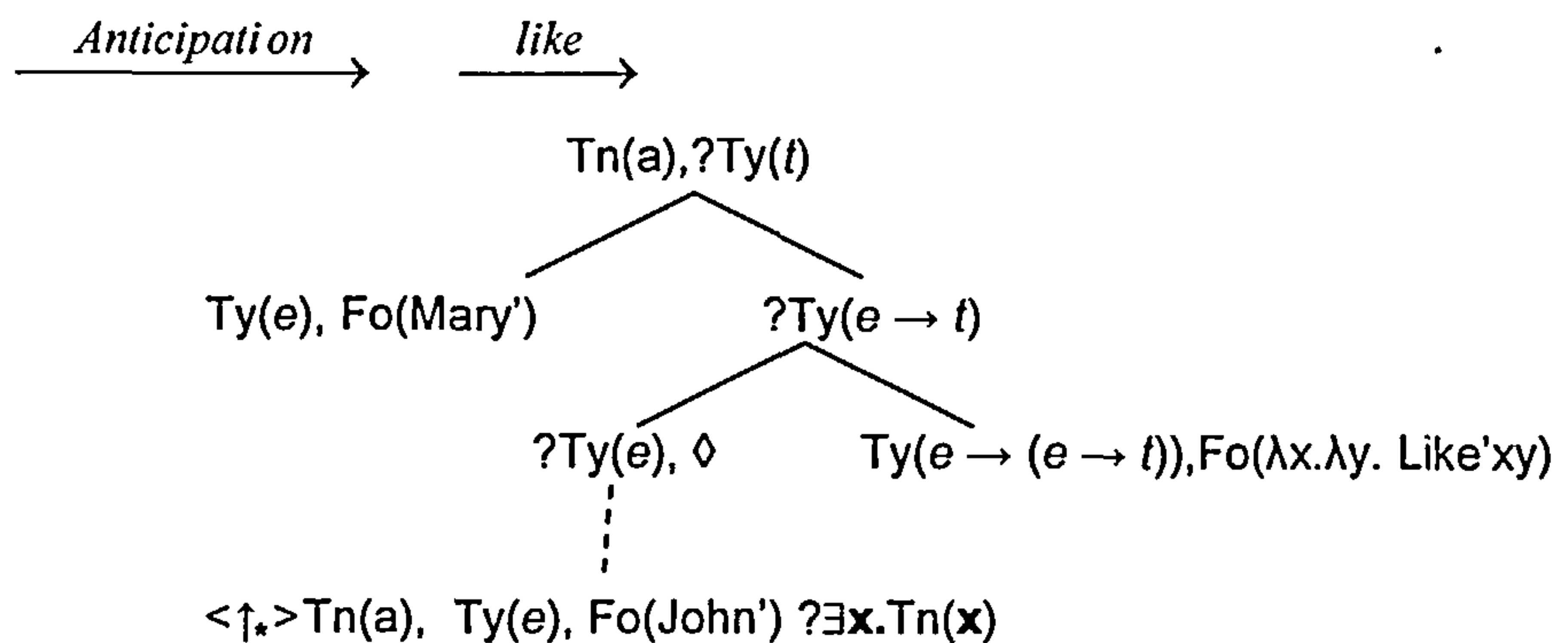
Going back to the continuation of our parsing example involving *Adjunction, Completion now moves the pointer from the $Ty(e)$ node upwards and the fact that there is a type e daughter is recorded at the root. The requirement for a type e daughter there is now satisfied and Thinning can apply to delete it:

(57)



The rule of Anticipation applies to move the pointer to the functor node where the requirement for a type $e \rightarrow t$ input is appropriate for the parsing of the word *like*. The unfixed node, satisfying the *Normal Form Constraint*, follows the pointer and is now hanging under the lowest $?Ty(e)$ node:

(58)



At this stage, the structurally underspecified node introduced earlier by *Adjunction has to find a fixed place on the tree otherwise its requirement will not be satisfied. For this reason, the rule of *Merge* comes into play.

5.a.10. Merge

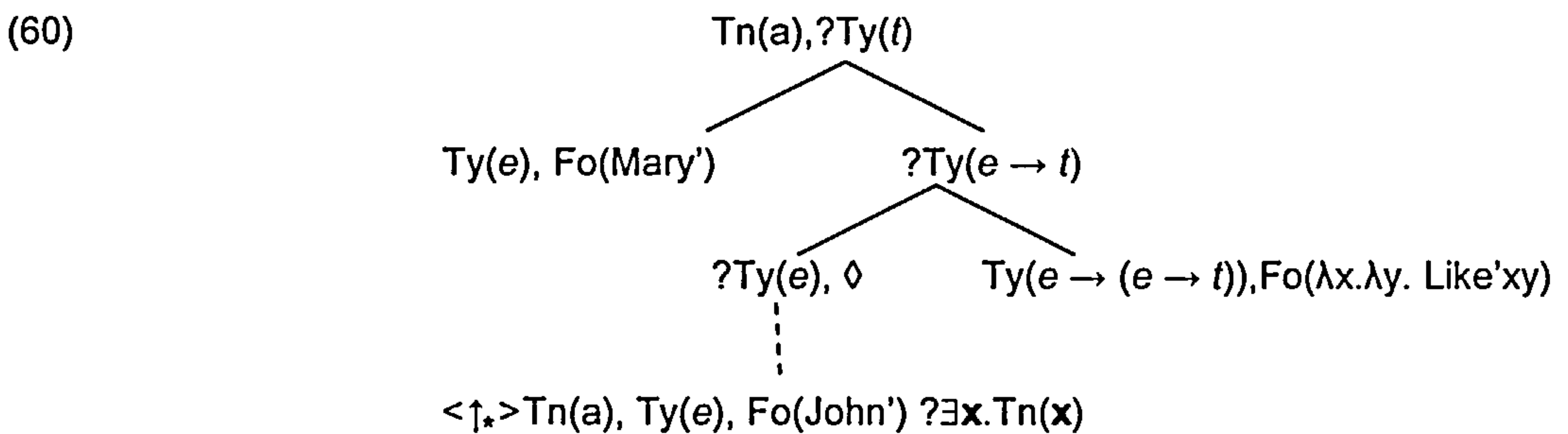
As the simplified description of the rule below shows, Merge licenses the unification of two node descriptions provided that their address specifications

are "compatible", that is, the address information carried by one of the nodes is entailed by the address information at the current pointed node. Entailment is defined according to principles which determine what are the legitimate extensions of partial tree descriptions to new ones. One such entailment relation involves the fact that an underspecified address, e.g., $\langle \uparrow_* \rangle Tn(a)$, can be acceptably updated to an address like $\langle \uparrow_0 \rangle Tn(a)$ or $\langle \uparrow_0 \rangle \langle \uparrow_1 \rangle Tn(a)$ etc. In that respect, an unfixed node will always be able to legitimately merge with another node inside a single propositional tree, given that its address will be compatible with the addresses at the other nodes. The only restriction to such a merging is a consistency constraint which ensures that two merged nodes do not bear conflicting information (we will expand on this a bit more at a later chapter). Below ND , ND' stand for arbitrary node descriptions:

$$(59) \quad \frac{\{... ND, ND'...\}}{\{... ND \sqcup ND' ...\}}$$

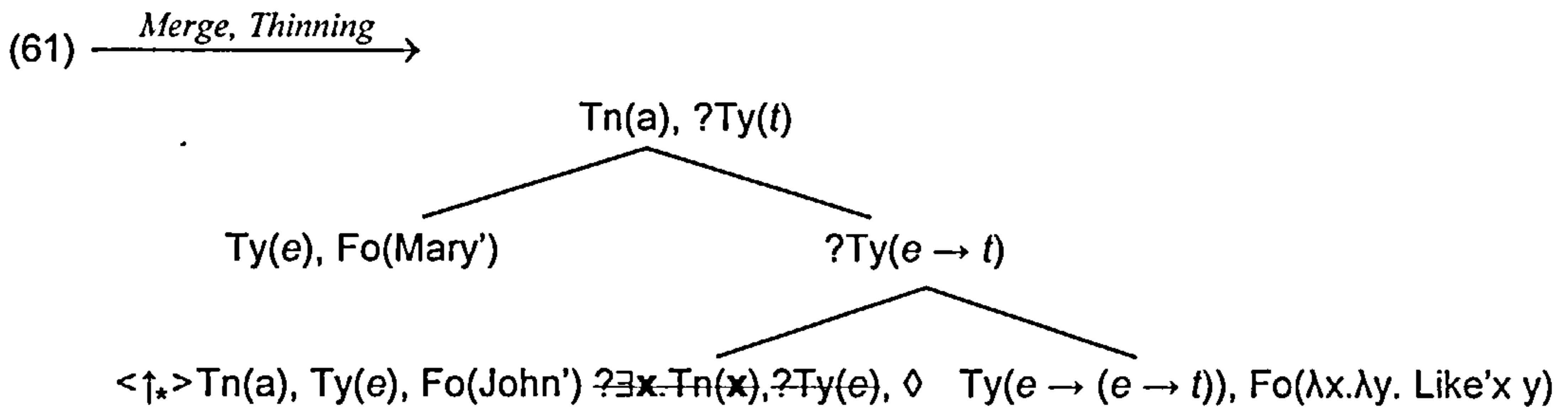
where $\diamond \in ND'$ and $\{ND \cup ND'\}$ is consistent

Continuing our example in (58) above, as we saw the Normal Form Constraint has resulted in the unfixed node hanging below the $?Ty(e)$ object node. This opens the way for Merge to occur especially since the two nodes bear compatible decorations:

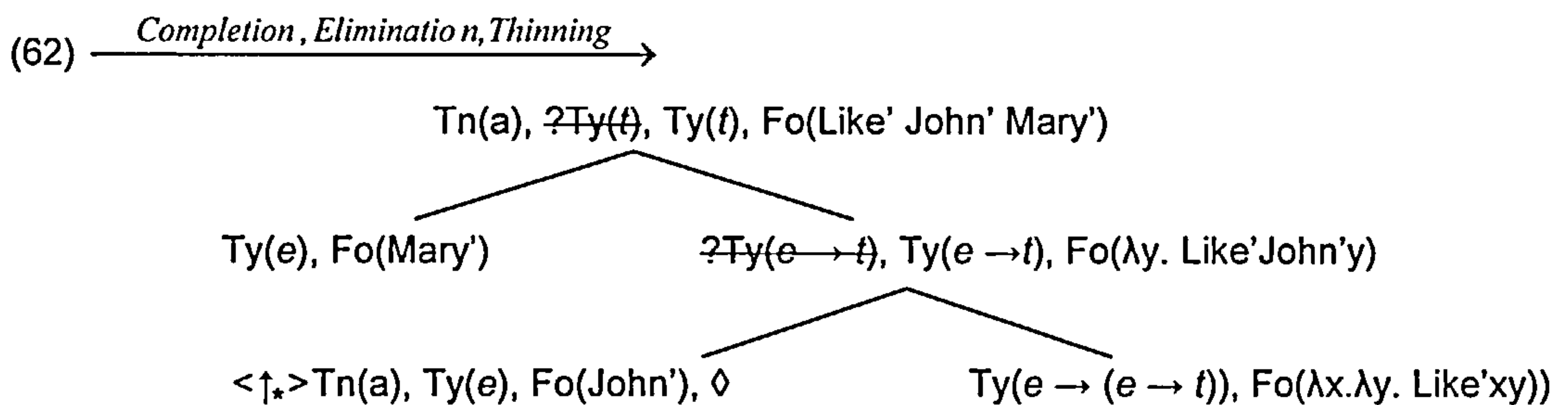


In fact Merge which is licensed to occur in such a situation becomes now necessary since with no more lexical input forthcoming the only way to satisfy the requirements on the unfixed node and fixed object node is for them to unify. This will result in a proper address for the unfixed node and a proper

formula value of type e for the object node. Moreover the annotation on the unfixed node that it appears somewhere dominated by $Tn(a)$ is also satisfied as the object node bears this dominance relation to the root. With all the requirements on this node now satisfied Thinning can subsequently apply and remove them:



The rules of *Completion* and *Elimination*, as well as *Thinning* again, will now apply to compile all the information on the non-terminal nodes and the tree will be successfully completed:

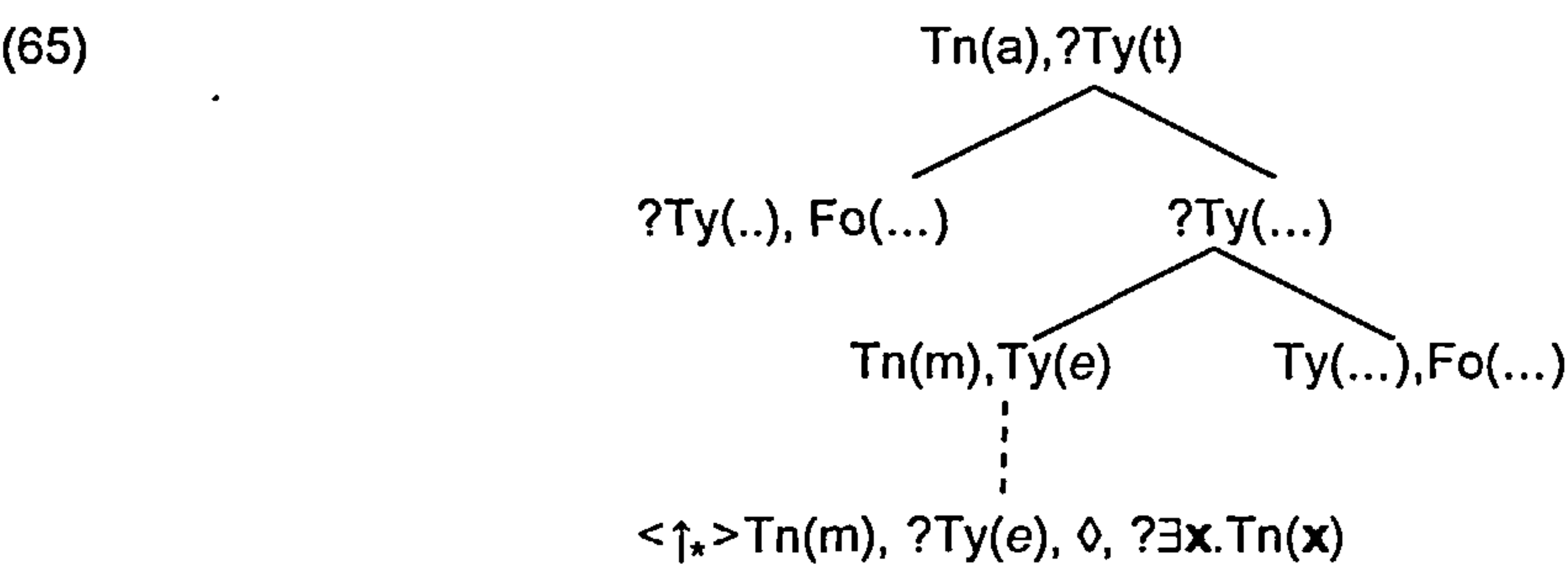
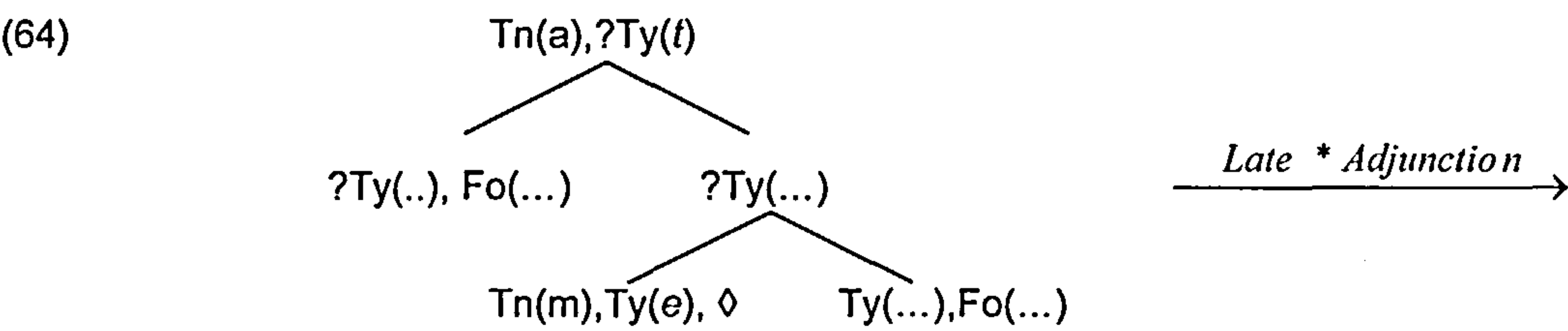


5.a.11. Late *Adjunction

The rule of Late *Adjunction is introduced in Cann et al. (2005) in order to deal with Right Periphery phenomena:

$$(63) \quad \frac{\{ \{Tn(n)\dots\}, \dots, \{ Tn(m), \uparrow_\star Tn(n), , \dots, Ty(X), \diamond \}, \dots \}}{\{ \{Tn(n),\dots\}, \dots, \{ Tn(m), \uparrow_\star Tn(n), \dots, Ty(X) \}, \{ <\uparrow_\star>Tn(m), ?Ty(X), ?\exists x.Tn(x), \diamond \}, \dots \}}$$

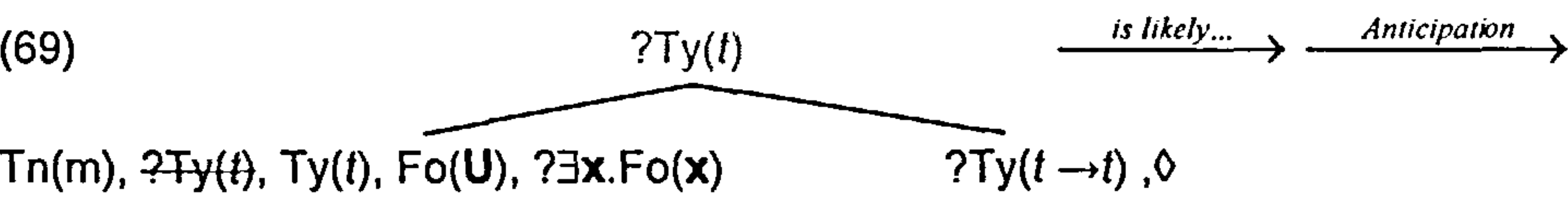
The rule applies at a node with a fixed type and creates a node bearing a requirement for the same type dangling underneath it. The pointer is moved to the newly created node so that lexical input of that type can be accommodated immediately afterwards:

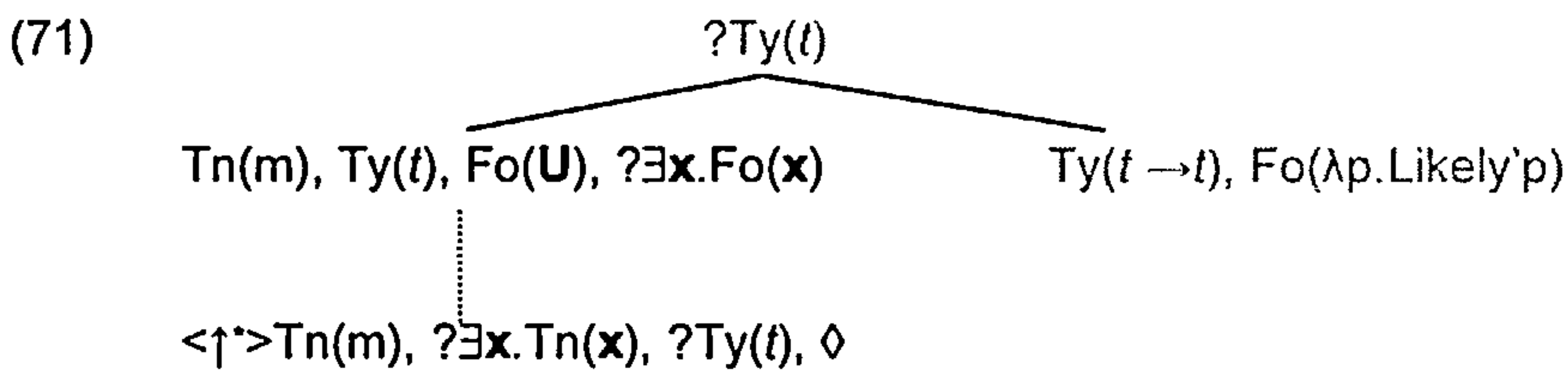
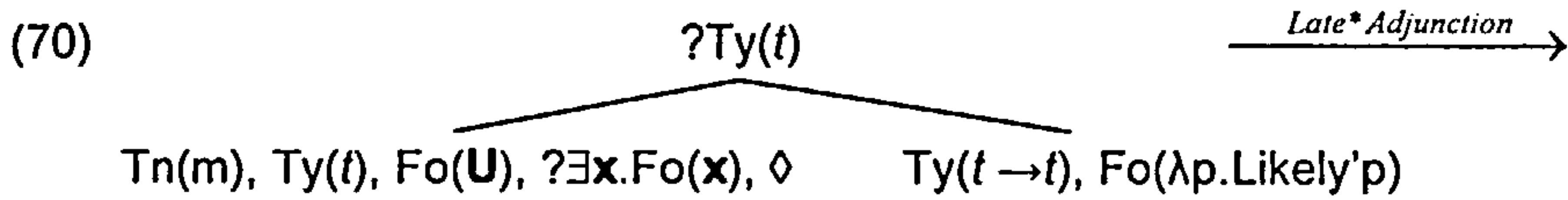


This rule allows for right-peripheral elements (e.g. associates of expletives in English) to be processed locally. For example in the following string the semantically empty (expletive) pronoun *it* occupies a position where normally the propositional subject should appear as is obvious of the truth-conditionally equivalent string in (67):

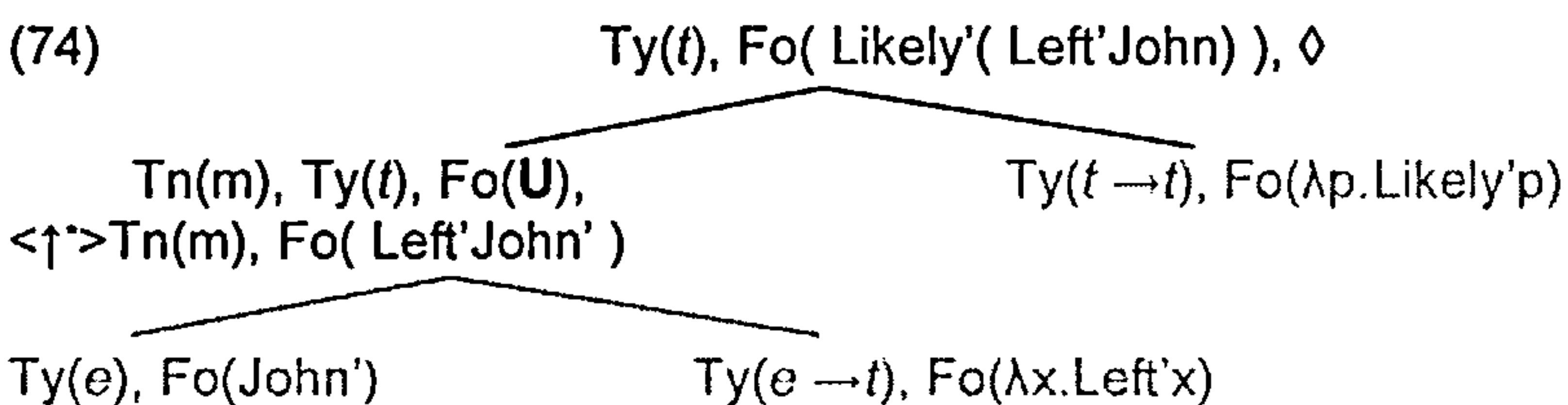
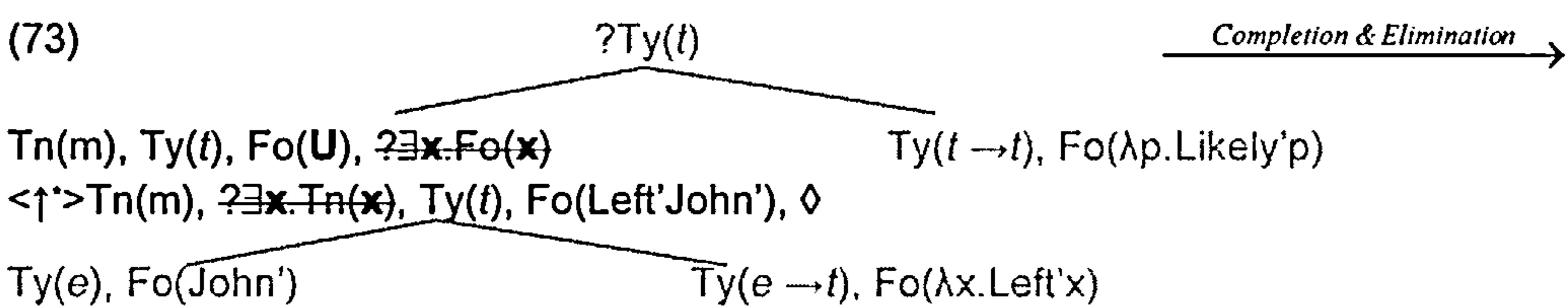
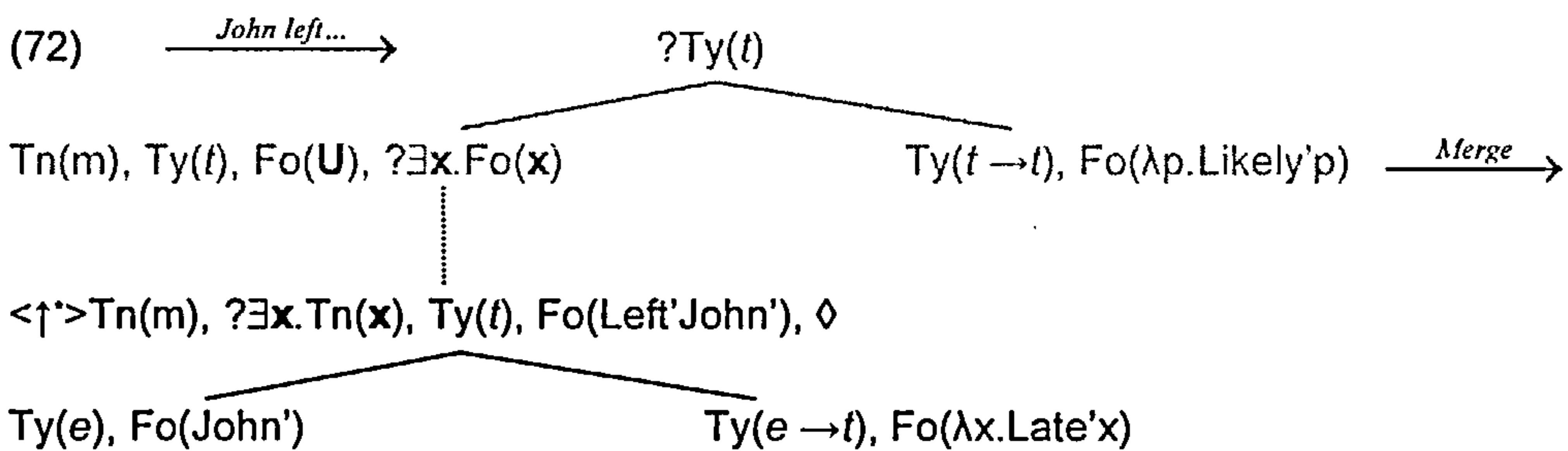
- (66) It is likely that John left.
(67) That John left is likely.

In order to allow parsing of the propositional subject in (66) at a later stage in the parsing of the string, the rule of *Late *Adjunction* will be invoked. This will happen at the stage when the pointer, having completed the predicate node, moves by *Anticipation* to the subject node which, however, is type-complete due to the earlier processing of the expletive.





The introduction of a type-incomplete, unfixed node dangling underneath the subject node will now allow the parsing of the propositional subject and subsequently Merge will effect the unification of the two nodes. The resulting representation will be identical to the one derived by parsing the string in (67) which is as it should be since the two strings must receive identical truth-conditional interpretations.



This completes the presentation of the main computational rules provided by DS. We will now deal with the issue of how to approach the analysis of quantification in DS.

CHAPTER 3
QUANTIFICATION IN DS

1. Introduction

Noun phrases in natural languages seem to behave all alike. In terms of their distributional properties, quantificational expressions like *every man* or *most dogs*, definites, indefinites and proper names all combine with predicates as their arguments. Moreover, in terms of their morphological/syntactic properties, noun phrases of different types are not distinguished according to whether they are quantificational or not. In languages where case, gender or other morphological features accompany noun phrases, the same features appear on quantifying expressions too. For example, in Modern Greek quantificational expressions, similarly to proper names, can be combined with determiners, bear case and agreement features and show similar syntactic distributions:

(1)	i perisoteri the most-Nom-Masc-Pl most students were late	fitites students-Nom-Masc-Pl	argisan were-late
(2)	tous perisoterous the most-Acc-Masc-Pl most students I saw (them) leaving	fitites students-Nom-Masc-Pl	(tous) ida na-fevgoun (them) saw-I to leave
(3)	polous many-ACC-Masc-Pl many students, I saw (them) leaving	fitites students-Nom-Masc-Pl	(tous) ida na fevgoun (them) saw-I to leave

Such evidence suggests that the structure of natural language does not indicate an absolute distinction between quantificational/general and non-quantificational/singular/referential noun phrases. However, in terms of semantic interpretation, it has been assumed that proper names (as singular terms) on the one hand and quantificational expressions on the other have meanings which distinguish them sharply from each other. Whereas proper names can be taken to refer directly to individuals, quantificational expressions cannot be regarded as such (see e.g. Geach 1962). Instead those expressions must be seen as denoting operators or higher order properties (of sets). In terms of representations that directly reflect the inferential properties of quantified sentences, in the tradition initiated by Frege and Russell it is assumed that the

apparent similarities in syntactic behaviour of all noun phrases is misleading and that natural language form does not properly represent the semantic structure or inferential properties of quantified sentences. For this reason, a distinct representational language is introduced which differentiates the contribution of directly referential (e.g. proper names) and quantificational terms: in the translation from natural language to the language of *predicate logic* quantificational expressions, unlike proper names, no longer contribute arguments of predicates; instead, quantification, as second order predication, is expressed by means of variable binding operators which predicate properties of the sets denoted by open formulae in their scope. This “regimentation” of natural language form is considered essential in order to bring out the inferential and truth-conditional properties of natural language sentences. A standard predicate logic representation for the sentence in (4) is shown in (5):

- (4) A man loves Mary
 (5) $\exists x [\text{Man}(x) \wedge \text{Love}(x, \text{Mary})]$

What is notable about the representation in (5) is that there is no single component in the formula that corresponds to the argument expression *a man*. The two constituents of the phrase have been split between an overarching variable binding operator \exists and a set denoting predicate *Man* inside its scope. Under this type of representation for quantificational terms, indeed, natural language structure is no guide to inferential potential as it obscures rather than elucidates the thought conveyed by the linguistic input; and, considered from a psychological point of view, this analysis implies that a significant amount of processing is required in mapping the linguistic input to a transparent semantic representation useful for purposes of inference. It also seems to imply that the mapping from linguistic input to semantic representations for natural language quantificational sentences could have been as arbitrary as, for example, the mapping between words and their meanings: if linguistic form bears no justifiable correlation to the thought transmitted and its efficient recovery then any arbitrary way of encoding these thoughts should be available to natural languages. Since,

against this view, it is observed that most languages³² seem to behave similarly in terms of exemplifying a characteristic predicate-argument structure for conveying various types of semantic content we have to assume that these similarities among languages are not accidental and must reflect universal characteristics of human psychology. Moreover, the fact that in no language there is an encoding of quantificational structures that is isomorphically transparent with respect to their predicate logic representations should make us suspicious about how much the syntax of predicate logic presented above is appropriate to reflect the syntax of the semantic representations recovered by the processing of natural language strings. Taking these considerations into account, there are three ways of addressing the issue of how to provide the desired mapping from surface linguistic form to the message recovered by language users in a way that does justice to a psychologically justified theory of language. We take each one of these in turn next.

The first way we can approach the issue is to maintain that it is the universality of the linguistic module in the human mind that imposes particular ways of associating thoughts and utterances. Under this view, there is a system dealing with *linguistic* representations that interfaces with semantic interpretation/inferential processes and there are *linguistic* mechanisms which provide for the mapping of the structures generated by phonological analysis (PFs) to truth-conditionally transparent forms (LFs). Since this intermediate system is autonomous, although universal, there is no reason to expect any isomorphism between surface linguistic structure and structure relevant for interpretation and inference since the two systems use distinct processes and vocabularies. This point of view is taken in *generative grammar*, for example, the framework of May (1977, 1985) and Heim & Kratzer (1998) (also Culicover & Jackendoff 2005). May proposes that the mapping between surface form and semantic interpretation involves an intermediate representation at the level of LF. The latter is a derivationally constructed phrase-structure representation onto

³² For disputed cases and their elucidation (in distinct terms than those employed here) see Demirdache & Matthewson (1995), Matthewson (2001).

which rules of semantic interpretation are applied. Every structural property that relates to interpretation is accounted for by reference to this level, for example, the scope of a quantificational term is defined as the c-command domain of the node it occupies. The system employs a transformational rule named *QR* which performs the appropriate mapping between surface forms and semantically transparent structures. Quantificational phrases which start life as the arguments of predicates in surface syntax are moved at higher positions on the tree so that their scope potential is explicitly represented. The traces left behind by phrases moved by *QR* as well as intra-sententially bound pronouns are treated as variables so that the eventual LF representation resembles the syntax of predicate logic with variable binding operators c-commanding their scope domains. The explanation of the distinct properties of referential terms and quantifiers is that *QR* discriminates between referential terms, which can appear as arguments of predicates at LF, and quantificational expressions which cannot. The question now that arises for such a system is why there are no natural languages where surface structures approximate closely the LFs assigned to sentences, especially since such languages would presumably be the most easier to process and acquire. Moreover, regarding the radical distinction between referential terms and variable binding-quantifiers, one could also ask how it is possible that, for anaphoric purposes, both types of element seem to behave similarly in that they introduce referents in a discourse which can be picked up by pronominals:

- (6) A man_i came in. He_i sat down.
- (7) Every soldier walked in. He picked up his gun and left without looking up.

Moreover the idiosyncratic behaviours frequently observed among quantificational expressions with similar truth conditional properties (see e.g. Vendler 1962 regarding the differences between *every*, *each*, *all* etc. in English) cannot be dealt with by general movement processes like *QR* unless elaborate and unwieldy phrase structure configurations are assumed to underlie the simple predicate argument structure of natural languages (see e.g. Beghelli & Stowell 1997).

The second way to approach the problem is the *surface-compositional* view exemplified by formal semantics accounts like *Montague Grammar* (see e.g. Dowty, Wall & Peters 1981). The solution here is to provide complex semantic rules mapping directly the surface form of natural language to its semantic interpretation (these rules might involve an intermediate level of representation in order to simplify presentation of the analysis but these representations must be dispensable). Since, according to the paramount principle of compositionality, syntactic and semantic rules must operate in tandem, the issue of how to discriminate the semantics of each type of noun phrase is resolved by assigning to all of them the most general interpretation and try to explicate the meanings that speakers find intuitive, e.g. referential interpretations, as derivative. In such an analysis all noun phrases are assigned contents of the type of a generalised quantifier, namely, $\langle\langle e, t \rangle, t \rangle$, i.e. they are analysed as functors taking the denotation of the verb phrase as their argument (in a non-intensional framework). On this view, a singular indefinite noun phrase like *a man* will be interpreted as the set of all subsets of the domain of discourse that have a non-empty intersection with the set of men; the expression *every man* will denote the set containing all the sets which have the set of men as a subset; and, counter-intuitively, the NP *John* has to be interpreted as the set containing all and only those sets which have the individual 'John' as a member. Although it is not generally the intention of such an analysis to account for psychological processes³³, the fact that it contradicts language users' intuitions both in terms of what the interpretations of NPs are and what is the predicate-argument structure of a sentence has to be taken as a point against it. Moreover, it seems that this type of generalisation as regards a uniform interpretation of NPs is not empirically adequate either, a fact which necessitates either partial abandonment of the principle of compositionality or the assignment of a single expression to a multiplicity of types to reflect distinct interpretations. The realisation that the higher type standardly assigned to NP content cannot be maintained leads Partee and Rooth (1983) to propose that NPs are ambiguous between interpretations of several types with type e the lowest possible one and

³³ see however Barwise & Cooper 1981: 191-194

a few higher types derivable by means of type-shifting. However, although processing considerations are offered as a justification for the lowest type operating as a default interpretation, it seems that there is no psycholinguistic evidence to support increased processing difficulty of referential as opposed to quantificational interpretations of NPs³⁴. Furthermore, on this account, one would expect garden-path effects when the lowest type assignment, once having been selected as the default, then has to be revised later in the parsing process. However, we are not aware of any such effects ever arising. Examining language users' performance as providing evidence for what semantic content should be assigned to NPs, Purver & Ginzburg (2004) discuss the evidence provided by clarification requests in naturally occurring conversation. No examples occur indicating that a hearer is expected to interpret a quantificational NP in the way a generalised quantifier analysis would predict, an expected result since, intuitively, it seems highly implausible that hearers ever interpret an NP like *a man*, *every man*, or *John* as denoting second order properties of predicates. In order to see how we could model what speakers/hearers actually attribute as the semantic content of NPs we need to examine now a third solution to the problem of providing a psychologically adequate NP content.

The third solution to the problem of how to explicate NP content is to take a more performance-oriented point of view, a strategy pursued by DS. Under a Fodorian conception of the human psychological mechanisms, natural language input is processed by means of allowing access to the representational language employed by inference processes (*LOT*). For a modelling of *LOT* and on the assumption that predicate logic constitutes a reasonable point of departure for capturing the semantic import of natural language quantified expressions, we could look into proof systems for predicate logic like *Natural Deduction*. Such

³⁴ e.g. there is no sense in which processing 'John and all the girls were smoking' is more complex than 'John, Mary and Sue are smoking' other than that associated with the increased complexity in processing lengthier sequences of words, frequency effects, familiarity etc. (in fact, depending on one's view of the interpretation of definites, there is tentative psycholinguistic evidence that there is no difference in processing between quantificational and referential NPs, see Carminati et al. 2002: 7-8 regarding the B-O-S reading times irrespective of binding/coreference which, in our view, affects re-reading times).

systems, which were explicitly designed as models of actual human reasoning (see Gentzen 1934/5), have recourse to the device of *arbitrary names* utilised as stand-ins when reasoning with quantificational formulae. Quantificational reasoning, under this assumption, is then conducted with formulas bearing a simple predicate-argument form. Assuming that such a system underpins human reasoning, quantificational terms in natural language can be modelled as nothing else but expressions whose processing provides such arbitrary names to be used in inference. Under this assumption, there is no need to strive to match, compositionally or otherwise, some 'autonomous' linguistic syntactic representation involving a VP-predicate and NP-argument structure with a non-isomorphic semantic representation nor to postulate a dichotomy in the processing of referential and non-referential expressions. Instead it can be assumed that the uniform formal characteristics (e.g. case specifications or word order) exhibited both by quantificational and by referential expressions point to the fact that such expressions are used invariably in order to provide 'names' which act as arguments of predicates. The formal uniformity of such terms in natural languages is therefore a consequence, not of a separate representational level of natural language structure, but of the structural uniformity that all such terms exhibit at the level of the inference language, LOT, to which natural languages give access to. On the other hand, the special interpretational properties exhibited by such terms, namely, scope dependencies, can be taken care of, not as a feature of the hierarchical positioning of the terms in a linguistic structural representation, but as an element of interpretation amenable to contextual determination and lexical idiosyncratic constraints. This avenue is not available to accounts which posit solely general-purpose quantificational mechanisms, for example, frameworks in which the scopal properties of NPs have to be accounted for by either transformational syntactic rules or semantic rules involving *quantifying in* or *storage*. In contrast, in DS, by assumption, as introduced earlier, the natural language system is a device for processing information in context and whose elements may systematically underspecify the interpretation assigned to them in any one occasion. This property is expected to

carry over into the quantificational system as it is a universal property of any type of cognitive processing.

We thus expect that the interpretation of quantified expressions may involve an additional process of enriching some very weak encoded specification, as part of the logical-form construction process; and in all such cases DS scope resolution will involve a combination of the time-linear processes of parsing quantificational phrases and whatever enrichment processes are required. A case in point is provided by *indefinites* whose scopal properties are notoriously unlike other quantifiers (Farkas 1981, Fodor & Sag 1982, Ludlow & Neale 1991, Abusch 1994, Farkas 1997). In other frameworks, indefinites are said to be multiply ambiguous, e.g. *specific, referential quantificational* etc.. In DS, because the mapping procedures from language to LOT are assumed to involve not only proprietary linguistic means but also general reasoning processes interleaving their operations with each other, the possibility arises of defining all such aspects of the interpretation of indefinites as arising by interaction of a weak *underspecified* content with its context of interpretation. Consider as an illustration (8) below where there is an ambiguity concerning whether there is only one thesis to be read, or multiple ones, one for each professor or one for each student:

- (8) Every professor insisted that most students should read a recent MIT thesis

This type of ambiguity is attributed by DS to the context dependent interpretation associated with indefinites. In contrast to other quantificational phrases which often seem to depend on order of processing for determining dependencies among them (witness the lack of scopal ambiguity between *every* and *most* above), indefinites can become dependent for their interpretation on any other scopal elements contributed to the representation by the surrounding sentential context. To implement this in DS we model the content derived from indefinite NPs as including an element of anaphoricity, in the sense that there is an enforced selection of some other term for it to depend on. Thus, as with any type of quantificational expression, there is no need here for general movement

operations displacing distinguished elements, or postulating ambiguity as to distinct types of indefinites or complex semantic mechanisms to derive the readings available. Instead an interpretation of uniform type can be assigned to each NP interpretation which reflects the fact that NP contents are usually the arguments of predicates. The fact that DS takes the mapping from language to denotations to be mediated by inferentially manipulated LOT representations provides the basis to achieve this result as well as an explanation of why natural languages are structured this way. Let's now see a more specific explication of the means provided by DS for the analysis of NP interpretation.

2. Quantification and epsilon calculus in DS

2.a. Natural language and Reasoning

As models for the way LOT operates DS takes the systems that have been developed under the name of *Natural Deduction*. These are systems specifically designed to simulate the way human logical reasoning operates (especially in mathematical proofs). Since the classical way of presentation of predicate logic by means of quantifiers and variables does not seem to reflect the way quantificational inferences are carried out in ordinary reasoning (see e.g. Rips 1994, Fine 1985), Natural Deduction proofs allow the replacement of quantificational statements by (provisional) statements which employ *names* standing for arbitrarily selected entities that are taken to verify the formula. The arbitrariness of choice for the names employed is ensured by the requirement that the name must be newly introduced in the proof (which in effect means that no (undischarged) assumptions involving this name have already been made). The use of name-like devices to eliminate quantifiers has been given formal substance in the *epsilon calculus*, which DS employs as part of the representational medium for the logical forms constructed by the parsing of natural language input. This assumption allows DS to assign a uniform name-like LOT representation as the content derived from all noun phrases; so here, unlike Montague-type semantics, all noun phrases map onto structured terms of type *e*.

2.b. The epsilon calculus

The epsilon calculus is a logical system originally developed by Hilbert & Bernays (1939). The version employed by DS is constructed on the basis of a predicate logic language to which two new operators are added: the epsilon operator, ε , and its dual tau, τ . For any predicate symbol in a predicate logic language, e.g. *Man'* or *Woman'*, we can form a new term by using these operators in the following way: (a) we add a variable as the predicate's argument, e.g. *Man'x* or *Woman'x*; this way we construct the *restrictor* of the epsilon/tau term, indicating the domain quantified over (b) the operator (*binder*) ε or τ is attached to the restrictor along with the variable it binds, for example, $\varepsilon, x, \text{Man}'x$ or $\tau, x, \text{Woman}'x$. The result of this process is a new term of the language which can be utilised as the argument of a predicate like any other term, e.g. *Sleep'($\varepsilon, x, \text{Man}'x$)*. Moreover, the term can have an arbitrarily complex restrictor constructed on the basis of propositional connectives and predicate symbols, e.g., $[\varepsilon, x, \text{Man}'x \wedge \text{Sleep}'x]$ or $[\tau, y, \text{Woman}'y \rightarrow (\text{Asleep}'y \vee \text{Happy}'y)]$.

Intuitively a term like $\varepsilon, x, \text{Man}'x$ denotes *some* individual that satisfies the predicate *Man'*, if there is such an individual, i.e. it picks a *witness* for the predicate *Man'*. Formally, the meaning of a term $\varepsilon, x, \text{Man}'x$ is given by adding a choice function Φ to a standard model for predicate logic $M = \langle D, I \rangle$ with D the domain of individuals, I a function mapping each elementary term of the language onto some element or set of elements of the domain D . The role of a choice function Φ is to select arbitrarily an individual for each subset of the domain D . This individual can be seen as standing for or representing the relevant set. If the restrictor of an ε -term denotes a set that has a non-empty extension according to the model then any of the individuals in this extension could have been selected as the denotation of this epsilon term (this property encapsulates the *arbitrariness* of the name):

$$(9) \quad \|\varepsilon, x, Px\|^{M,g} = \Phi(\|P\|^{M,g}), \text{ with } \Phi \text{ as a function given by } M = \langle D, I, \Phi \rangle$$

On the other hand, if the restrictor of the ε -term stands for a set that has no members according to the model, i.e., the restrictor stands for the empty set \emptyset , then the choice function Φ selects arbitrarily any member of the domain D to assign as the denotation of the ε -term (in some formulations an *absurd* individual is selected, see e.g. von Stechow 2000):

$$(10) \quad \Phi(\emptyset) \in D$$

Thus an epsilon term always has a denotation whether its restrictor stands for the empty set or not. This property of the epsilon calculus allows it not only to enrich but also supplant the standard language of predicate logic. This is because the quantifier symbols, \forall and \exists , can be eliminated completely from the language and we can work with the epsilon and tau symbols only. The fact that the choice function interpreting the epsilon symbol always selects an individual whether its restrictor has an extension or not means that the following equivalences hold:

$$(11) \quad \exists x P(x) \leftrightarrow P(\varepsilon, x, Px)$$

$$(12) \quad \forall x P(x) \leftrightarrow P(\varepsilon, x, \neg Px)$$

If there are some individuals in the extension of the set P then the choice function by definition will pick out any of those individuals as the term's denotation and that selected individual will of course have the property P . On the other hand, if every individual in the domain has the property P then the denotation of the predicate $\neg P$ will be the empty set. Since an epsilon term with a restrictor that denotes the empty set is interpreted as picking out an arbitrary individual from the domain D and since we know that all individuals are P the arbitrarily selected individual cannot fail to be a P too. We can exploit this latter equivalence to introduce the τ -terms as the duals of ε -terms:

$$(13) \quad (\tau, x, Px) = (\varepsilon, x, \neg Px)$$

$$(14) \quad \forall x P(x) \leftrightarrow P(\varepsilon, x, \neg Px) \leftrightarrow P(\tau, x, Px)$$

Although the epsilon calculus is a conservative extension of first order predicate logic in that no new theorems can be derived in it, it is more expressive than predicate logic in that not all formulas that can be formed by epsilon and tau

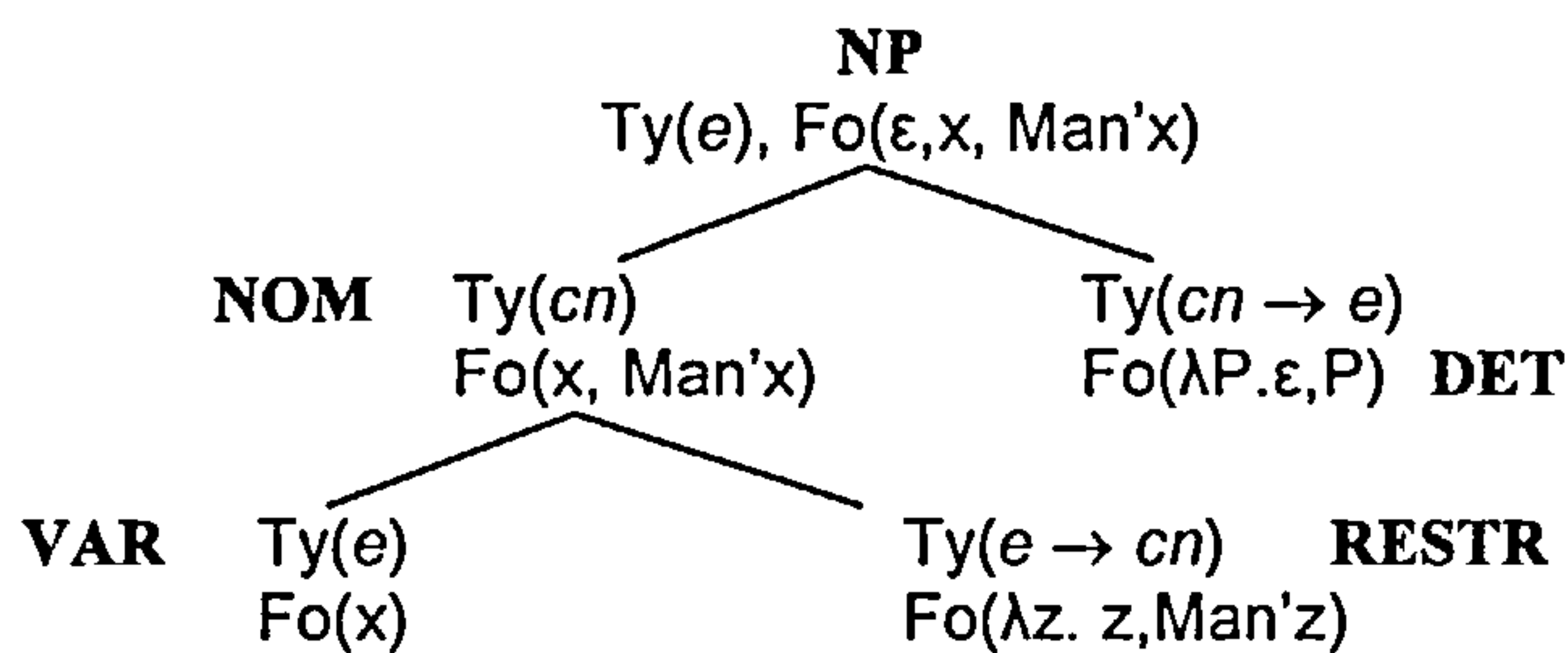
operators have direct translations in a predicate logic language. Moreover, for our purposes, what is crucial is that epsilon/tau terms can be made to directly encode in their internal structure the dependencies in interpretation that arise during the parsing of successive NPs in natural language discourse. This latter property of these terms allows us to pursue a more “constructive” view of context in that it provides us with the appropriate terms which can be picked up as the content of subsequent anaphoric linguistic items. A full specification of dependencies on other terms as part of the restrictor of a particular term, in effect, keeps a record of how terms are built up. This has the consequence that the resulting context containing these terms has a much richer structure than in modellings couched in strictly semantic terms. As we shall see in due course, this provides an obvious advantage in the characterisation of *E-type* effects (see e.g. Evans 1980) in the analysis of anaphora.

We now move to examine how DS defines the construction of these terms through the projection of tree structure arising from the processing of linguistic input.

2.c. The tree representation of NP content

As we said earlier, in DS, all NPs are treated as contributing structured objects of type *e* to the final semantic representation. The final structure of these objects is achieved by function application and type deduction on daughter nodes of subtrees that have been incrementally constructed through the parsing of the different components of an NP: the determiner, the noun and any adjectives or relative clauses accompanying them. The final output of processing an NP like *a man* in DS is a tree of the following general format (the shaded labels are just convenient names for the nodes so that we can refer to them quickly in the subsequent discussion; they do not play any role in the formal framework/parsing process):

(15)



The highest node, shown as NP here, is the node where the completed term appears after it has been progressively constructed by compiling the information on its constituent nodes (this is the node characterised as DP in generative grammar frameworks). The node indicated as DET is where the natural language determiner supplies information about what kind of quantification we are dealing with: an NP with a determiner like *a* or *some* will eventually contribute an ϵ -term (ϵ, x, Px) whereas an NP with a universal determiner like *every* or *each* will contribute a τ -term (τ, x, Px); other quantificational terms can be defined similarly. The Formula value at the DET node is a functor which takes the Formula value at its sister NOM as its argument. Parsing of any determiner will result in the construction of an object of type $cn \rightarrow e$ but different determiners can also contribute various idiosyncratic features in the structure (e.g. Indef (-/+)) besides establishing the manner of quantification (existential, universal etc.). The noun accompanying the determiner, e.g. *man*, contributes a sub-tree containing a variable as Formula value on the node VAR, and a function occupying the node RESTR (for restrictor). The function appearing on node RESTR will apply on the variable with the result of constructing an appropriately structured argument for the function inhabiting the DET node. The reason for giving the nominal variable its own node is because we need to be able to reflect the fact that natural language input might provide this variable with additional restrictions in the form of (restrictive) relatives and adjectives. Note therefore that there are two type e nodes involved in a subtree representing the derivation of a term.

Now one of reasons that DS utilises the epsilon calculus for the representation of the content of NPs is that dependencies that might arise among them can be explicitly recorded. This requires a precise definition of how scope dependencies are constructed during the processing of linguistic input. We turn therefore to a presentation of how this is defined formally in DS terms.

2.d. Scope

Sentences containing multiple quantificational elements can result in interpretations in which there are dependencies among them. As is well-known, in a predicate logic language, this is expressed by the linear position of each quantifier symbol and the brackets indicating each quantifier's scope. The semantic rules then interpret such formulas by examining assignments of values to variables in order to determine whether the formula expresses a true proposition or not in a model on the basis of truth of the open formula under the assignments. As we have seen this standard practice of symbolising quantificational interpretations does not comport well with an incremental, compositional process of deriving content from natural language. For this reason, in the version of the epsilon calculus employed by DS, dependencies that might arise among terms are ultimately explicitly encoded inside the structured terms themselves. Reflecting the incrementality of processing, the construction of these complex names has to be a two stage affair: first, as a result of parsing an NP, an initial, uninterpreted, "incomplete" term is constructed. Along with it, a requirement will also appear on the tree indicating that there must be a scope/dependency relation between the term constructed and the other terms in the same propositional structure. However, determination of exactly what kind of scope relation this will be cannot occur at this stage. DS assumes that scope relations among terms are partially constrained by the order of presentation of the linguistic input, partially determined by lexically encoded idiosyncratic requirements of certain elements and, moreover, they can be partially underspecified in that complete determination involves an element of pragmatic choice. Thus the initial term provided by the linguistic input (the NP) is only a

provisional name which has to be expanded when all dependencies among terms have been finalised. There is no semantic interpretation assigned to that name exactly for this reason. Eventually, at the time of completion of the parsing routine for a sentence, a process will apply which will construct the final complex terms. These complex names now will encode in their internal structure what kind of dependencies have been assumed to hold among them. They can now also be semantically interpreted by the choice function semantics standardly assumed for the epsilon calculus. For illustration, consider the sentence (16) below:

(16) Every woman saw a man

At the first stage of parsing such a sentence the following formula will be constructed at the top node of the tree³⁵:

(17) $Fo(\text{Saw}' \varepsilon, x, \text{Man}'x \ \tau, y, \text{Woman}'y)$

This formula is incomplete in that there is no way of knowing whether it is a specific man who every woman saw or whether for each woman there is a (potentially different) man who she saw, that is, we do not know whether the choice of man depends on the choice of woman or the other way round. In order for the ambiguity to be resolved the formula in (17) will always be accompanied by a *Scope Statement* which will unambiguously indicate which term depends on which other. In such a scope statement a term is represented by the variable it binds (e.g. the term $\varepsilon, x, \text{Man}'x$ above will be represented by x). This variable is guaranteed by the parsing rules to be fresh and unique for each term. The variables in a scope statement are presented as ordered according to their dependencies. The particular ordering found in each representation is usually the result of pragmatic actions and is indicated by means of the predicate *Scope*:

(18) $\text{Scope}(x < y)$

³⁵ Dotted underlining will sometimes be used instead of brackets to improve readability. When brackets are not used to indicate the order of the arguments the convention we assume is that the object is closer to the predicate than the subject. For example, 'Saw' $\varepsilon, x, \text{Man}'x \ \tau, y, \text{Woman}'y$ is equivalent to: 'Saw'($\varepsilon x \text{Man}'x$)($\tau y \text{Woman}'y$)' with the interpretation: 'Every woman saw a man'.

The symbol $<$ between the two variables x and y indicates that the term employing the variable on the left ($\epsilon, x, \text{Man}'x$) outscopes the term employing the variable on the right ($\epsilon, y, \text{Woman}'y$). If such a Scope Statement accompanies the formula in (17) above then the interpretation that it represents would be expressed in predicate logic as follows:

$$(19) \quad \exists x [\text{Man}'x \wedge (\forall y \text{ Woman}'y \rightarrow \text{Saw}'xy)]$$

On the other hand if the dependency is presented the other way round, i.e.,

$$(20) \quad \text{Scope}(y < x)$$

then the equivalent interpretation in predicate logic will be:

$$(21) \quad \forall y [\text{Woman}'y \rightarrow (\exists x (\text{Man}'x \wedge \text{Saw}'xy))]$$

The formula in (17) and the Scope Statement accompanying it will be utilized at the end of the parse as input to a rule of quantifier evaluation (*Q-Evaluation Rule*) which will construct the appropriate complex terms that record inside their restrictors the scope dependencies selected to hold.

In order to show in detail how all the various rules interact in the parsing of sentences with quantificational expressions we will go through the incremental construction of a semantic representation for a sentence with two quantifiers next.

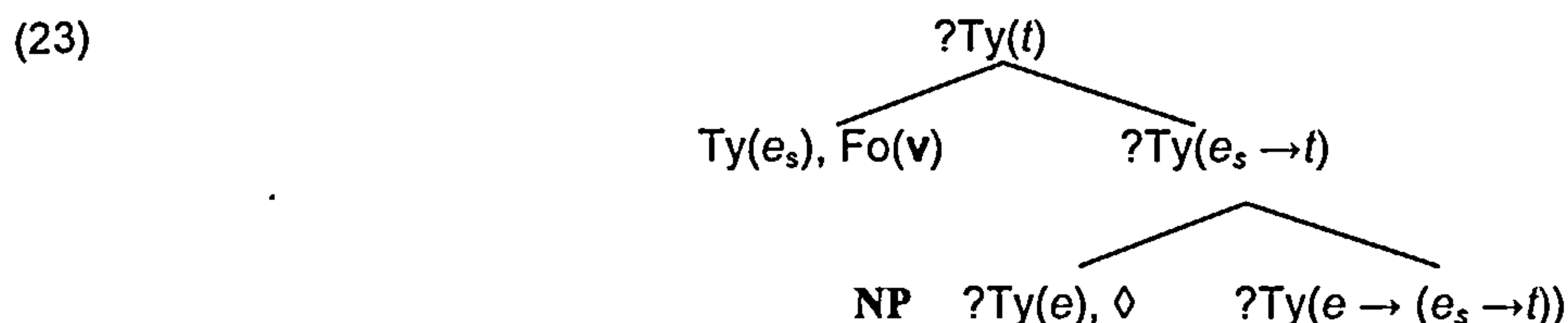
2.e. An example of parsing a quantificational structure

We now present the DS routine for parsing a sentence like:

$$(22) \quad \text{A man saw every girl.}$$

As always, the parsing starts with the pointer at the $?Ty(t)$ node. Here we will also assume that the situation argument, initially a metavariable **S**, will be inserted after a step of Introduction and Prediction and the application of an appropriate computational rule (we discuss this process in more detail in Ch.

5)³⁶. The metavariable **S** can be immediately substituted by a free variable *v* which we assume is accessible in the context. After that, Introduction and Prediction again will build the nodes for the subject and the predicate. The pointer now appears at the $?Ty(e)$ node that has been newly created:



The parser now encounters the indefinite determiner *a*. This will trigger the activation of the lexical entry for *a* which includes the following instructions for the parser to follow:

(24) **a**

IF $?Ty(e)$

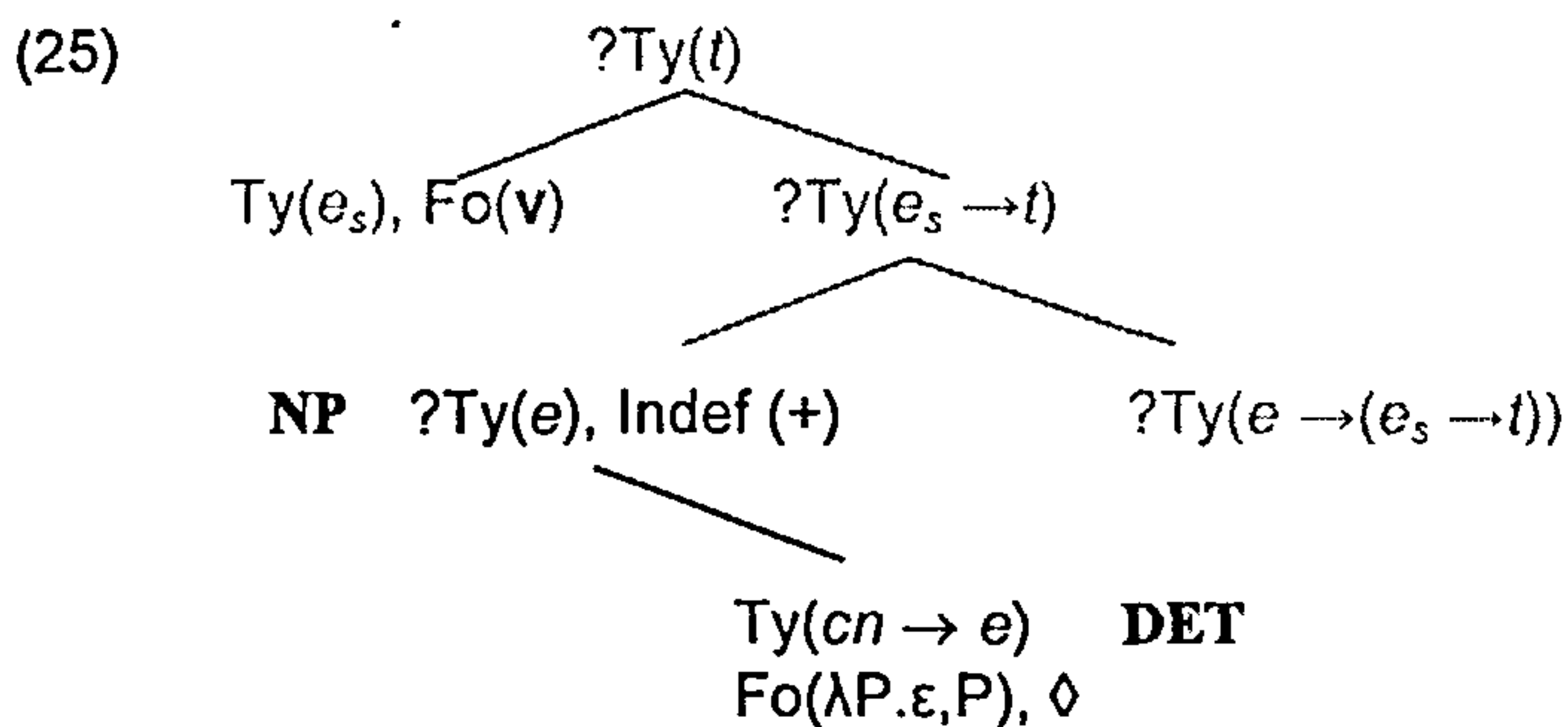
THEN $put(Indef(+)); make(<\downarrow_1>); go(<\downarrow_1>); put(Fo(\lambda P(\varepsilon, P)), Ty(cn \rightarrow e));$
 $go(<\uparrow_1>); make(<\downarrow_0>); go(<\downarrow_0>); put(?Ty(cn))$

ELSE abort

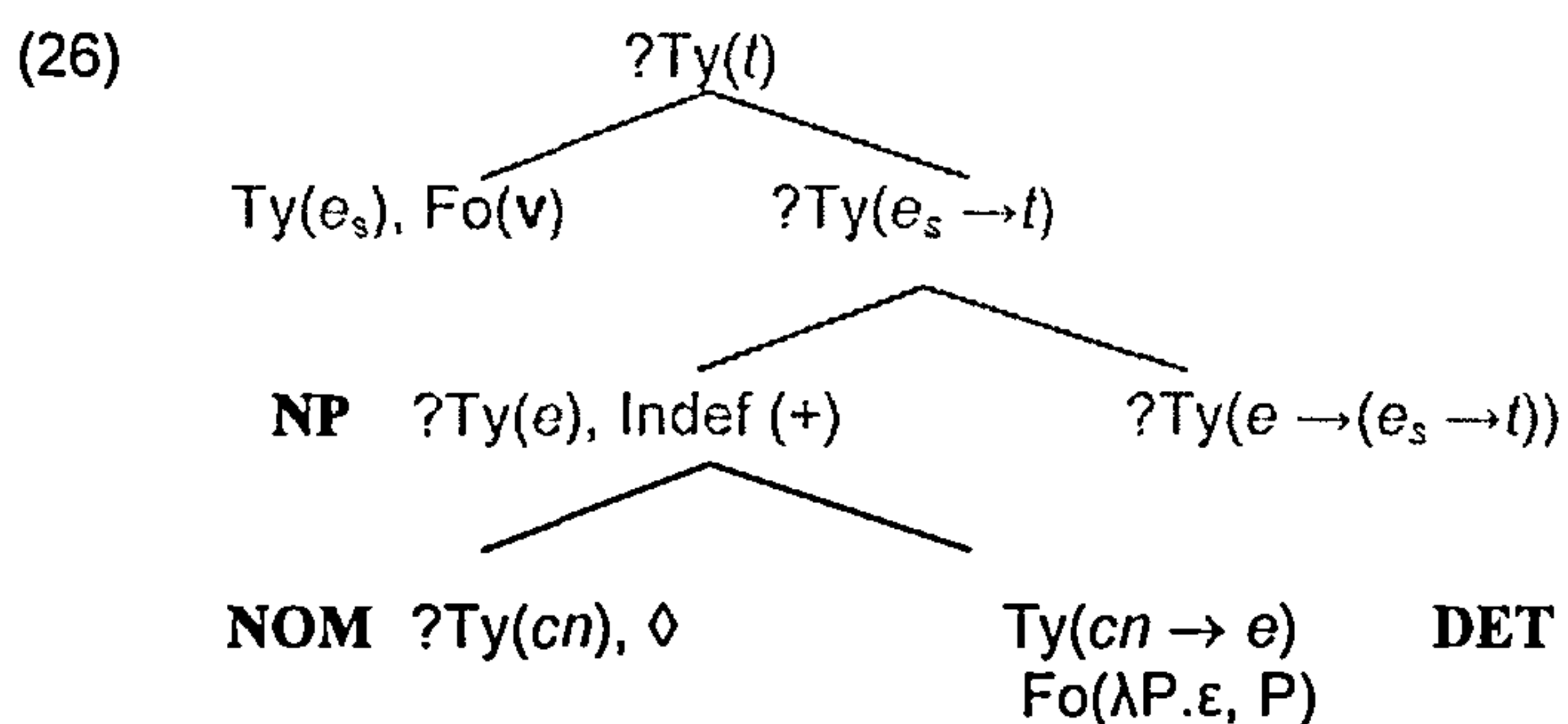
If the pointer is currently at a node with a requirement for a type *e* formula value ($?Ty(e)$), then the specification above determines firstly that the feature *Indef(+)* will be inserted there. This is because the expression *a* initiates the construction of an indefinite quantificational name, i.e. a necessarily dependent term, whose scope is partially underspecified by the linguistic input. Later scope resolution rules will depend on the presence of this feature for their appropriate application. Next in the instructions comes the construction of the node's function daughter and movement of the pointer there. The new node, highlighted with the label

³⁶ In Kempson et al. (2001), Cann et al. (2005), the situation/event argument is represented as a label eventually inserted at the front of the formula, e.g. $Fo(S: Saw(\underline{T}, \underline{y}, \underline{Girl!y}, \underline{\varepsilon}, \underline{x}, \underline{Man!x}))$. In the present treatment, we adopt a view of event/situation terms as parts of the tree rather than external labels. One of the reasons for this is the ability of these terms to take scope with respect to other terms contributed by nominal phrases. World labels will be treated as labels, see Chapter 4.

DET³⁷ on the tree below, will be annotated with the Formula value $(\lambda P.\varepsilon, P)$, i.e. a function which requires an argument of the appropriate shape (an open formula with a distinguished variable) in order to built an epsilon term by applying to it. The node is also decorated with the type specification $Ty(cn \rightarrow e)$ which indicates that the type of argument that is expected can only be provided by linguistic input in the form of a common noun:



Next the instructions in (24) indicate movement of the pointer to the NP node above. From there the left daughter, the argument daughter NOM, is created. The pointer moves to that newly created daughter and a decoration is inserted with a requirement for the type of the formula value that appears there to be *cn*. The tree now looks as follows:



Now the tree awaits lexical input that will provide a formula of type *cn* in order for the parsing to continue. Processing of the common noun *man* provides the

³⁷ The labels NP, DET, VAR, NOM and RESTR are here used just as names of nodes for illustrative purposes and have no status whatsoever in the mechanics of the formalism. One should note that, unlike here, in Kempson et. al. (2001) these labels encode modal addresses. We will not use that notation here.

appropriate input by giving access to a lexical entry which contains the following instructions:

```
(27)      man:

IF          ?Ty(cn)

THEN        make(<↓1>); go(<↓1>); put(Fo(λx.x, Man'x)), Ty(e → cn);  } RESTR

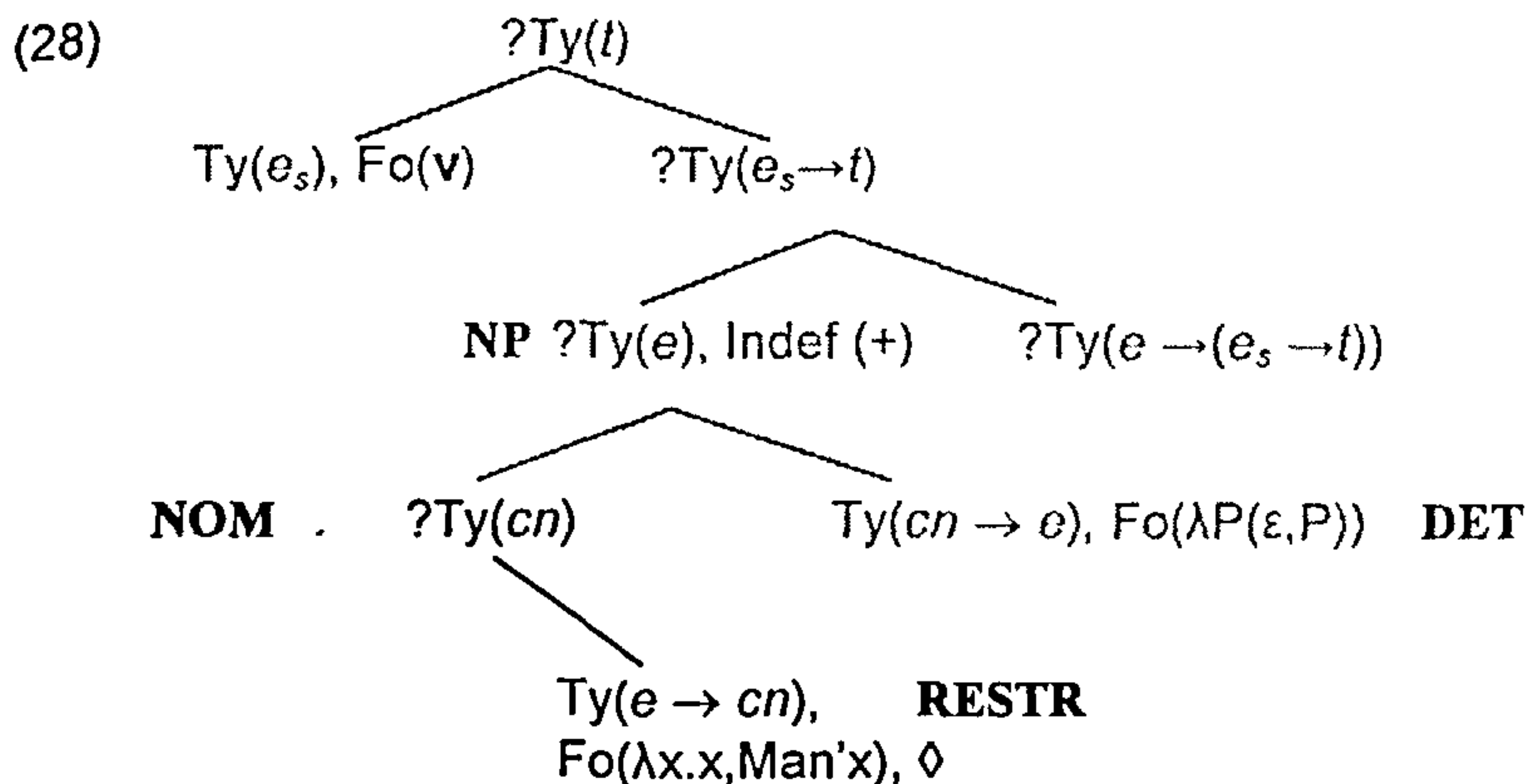
           go(<↑1>); make(<↓0>); go(<↓0>); freshput(x, Fo(x)); put(Ty(e)); } VAR

           go(<↑0>); go(<↑0>) put(?Sc(x))38; go(<↓0>); go(<↓0>).

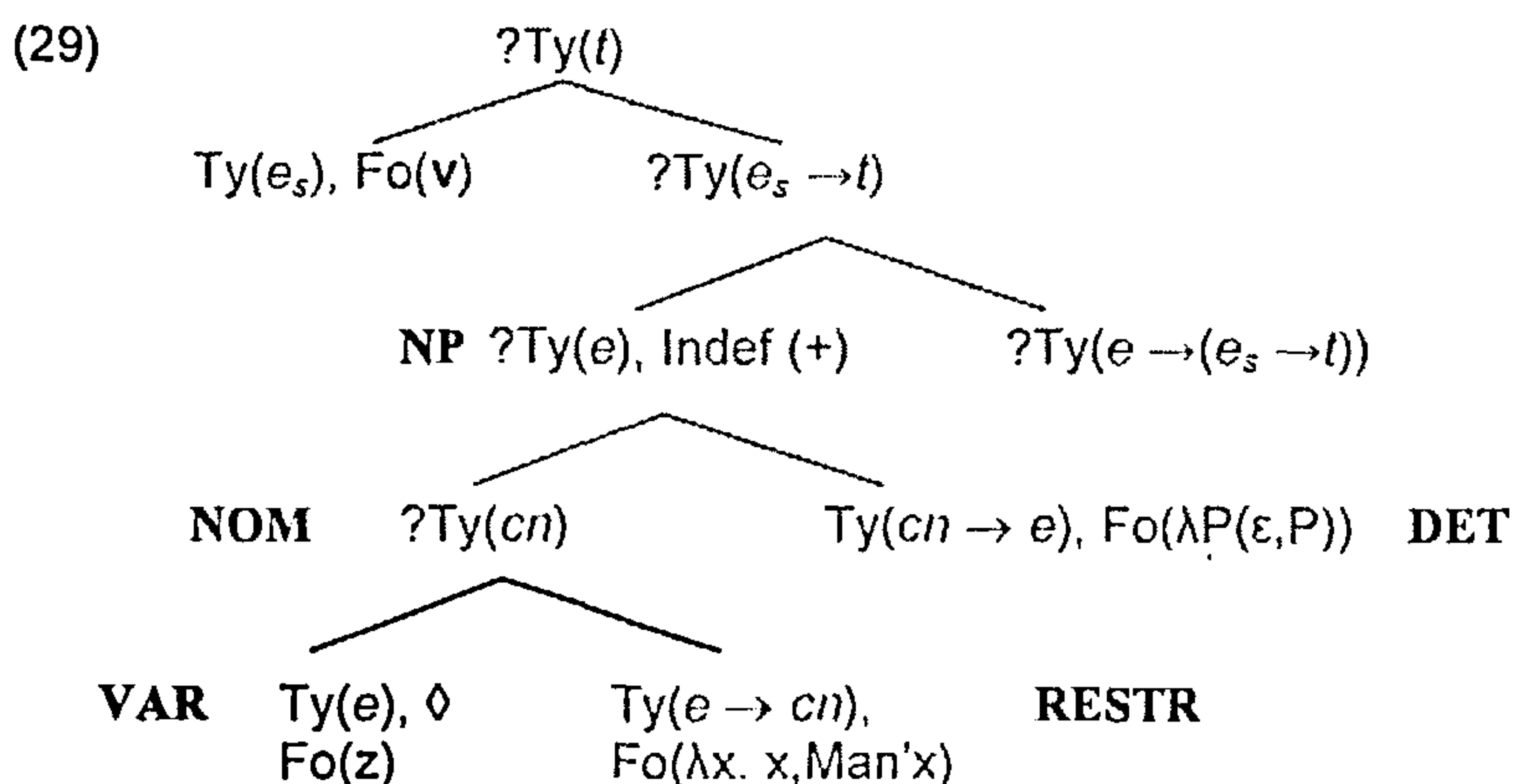
ELSE        abort
```

For the noun input to be incorporated in the tree the pointer must reside on a node with a requirement ?Ty(*cn*). As this is the case in our example the rest of the actions specified can be executed: Firstly the function daughter, *RESTR*, is created and the pointer moves there. A formula and a type specification are inserted: Fo(λ*x*. *x*, Man'*x*), Ty(*e* → *cn*). The formula value is a function that requires a type *e* variable as its argument in order to build a restrictor of the appropriate shape for the epsilon calculus term that will eventually be constructed. This variable that will become bound by the ε or τ operator is therefore distinguished by appearing in two places inside the restrictor: on its own separated by a comma and inside the common noun predicate in argument position (e.g. *x*, Man'*x*). Accordingly, the type of the node indicates that it requires something of type *e* in order to result in a structure of type *cn*. Here is the tree resulting from this:

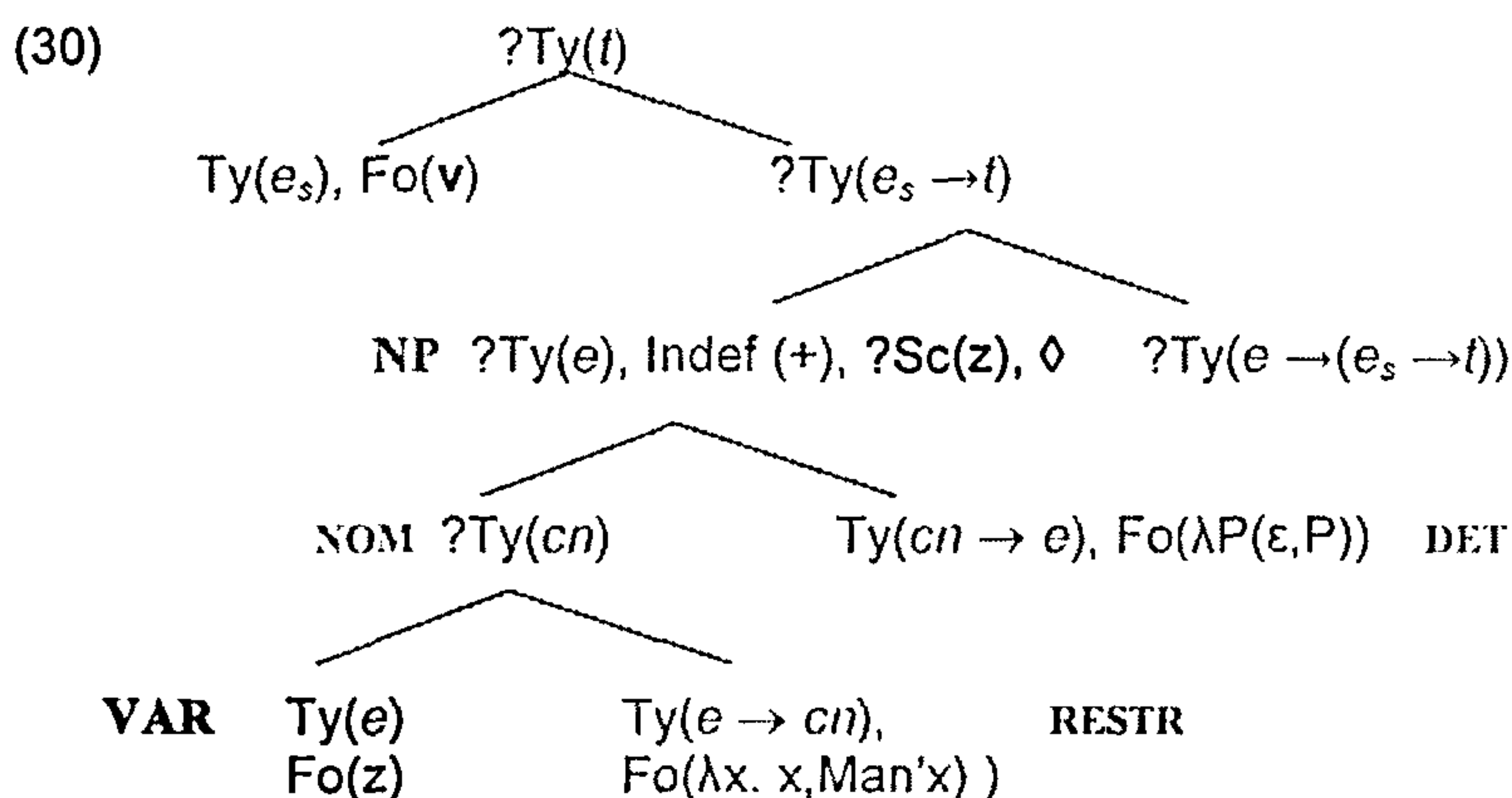
³⁸ The actual action at this point should have the form: < {<↓₀><↓₀> (**x**)}, put(?Sc(**x**)), Abort> which is an IF THEN statement for seeking the variable at the VAR node and entering the scope requirement for it. We use instead a simplified notation for simplicity of presentation.



After completing the decorations on this node, the lexical entry for the noun *man* indicates that the pointer should move at the mother node **NOM** above and the other daughter, the left daughter **VAR**, is created. The pointer moves to this newly created argument daughter and now its type and formula values must be placed there. Because we need a fresh variable as formula value on this node the action *freshput* is invoked. In simple terms, this action checks the rest of the tree under construction and inserts, as formula value on the current node, a variable that has not appeared anywhere else (this ensures that each epsilon calculus term will be associated with a unique, fresh variable and there will not be any accidental bindings; it also reflects the fact that use of such terms introduces new “referents” in the discourse context). Assuming that the fresh variable selected was *z*, the annotation *Fo(z)* is placed on the node as well as its type: *Ty(e)*:



After completing the decorations on this node one last thing remains before completion of this particular subtree: we must ensure that the epsilon calculus term created will eventually participate in some scope relation with the other quantificational terms on the tree; otherwise, the interpretation of the natural language string will remain incomplete. In order to achieve this a *scope statement* will need to be constructed later including the variable employed by this particular term now under construction. So inside the lexical entry associated with the common noun we need to have the means to address the newly introduced variable (*z* in our case) which will be taken as a representative of the entire quantificational term inside the scope statement. In the language in which the lexical entry's instructions are formulated, bold variables by definition range over any actual formula value that might appear on a node. Therefore by use of the bold variable ***x*** in the formulation of the instruction `put(?Sc(x))` in the lexical entry in (24) we are able to pick up the actual fresh variable *z* standing currently as the Formula value of the VAR node. Having picked up that variable we can now construct a requirement that concerns it, in this case the requirement: `?Sc(z)`. This requirement is inserted at the highest type *e* node, NP:



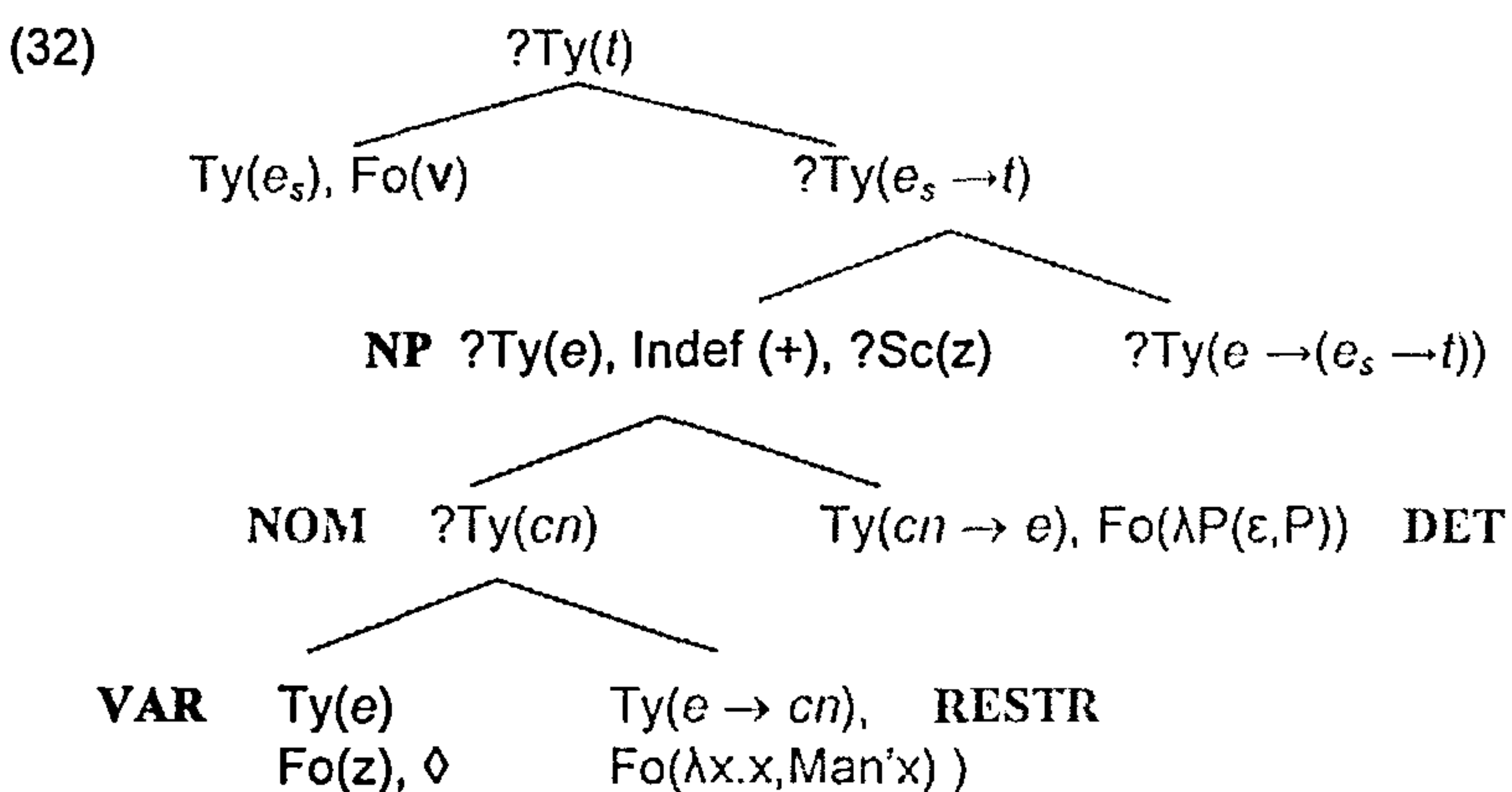
What this requirement means is explicated by looking at the definition of the monadic predicate *Sc*. This predicate is in fact an abbreviation of a complex specification defined as follows:

(31) $Sc(a) =_{df}$
 $(\langle \downarrow_0 \rangle \langle \downarrow_0 \rangle Fo(a) \wedge Ty(e)) \wedge \langle \uparrow_* \rangle (Ty(t) \wedge \exists y (Scope(a < y) \vee Scope(y < a)))$

The above definition says that for a formula value/variable a to satisfy the predicate Sc , firstly a itself must appear as Formula value on a completed VAR node found in the local subtree below the node where the predicate is evaluated. Secondly, this node must be dominated by a type t propositional node bearing a decoration (a *scope statement*) which indicates that a is involved in some scope dependency (this is indicated by the annotation employing the predicate *Scope*). This means that a has wider or narrower scope with respect to some other variable on the tree.

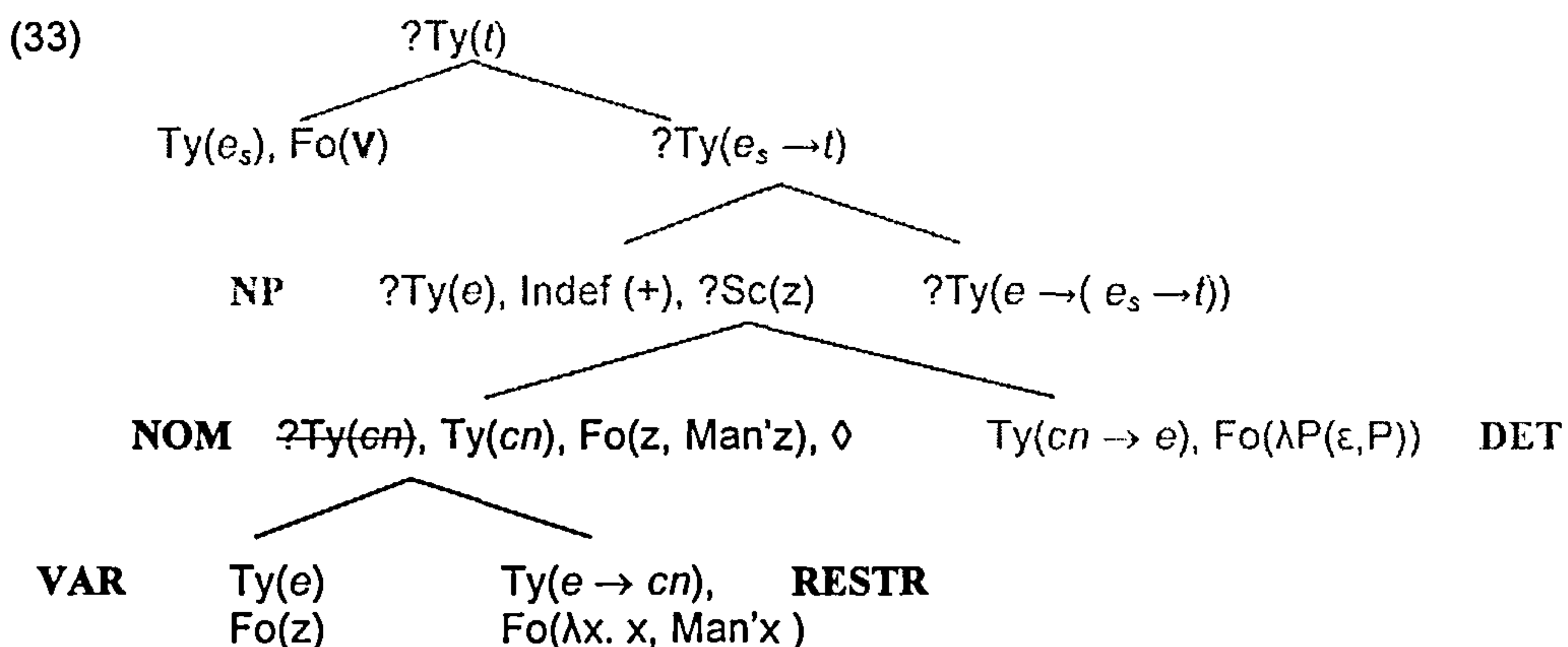
Going back to our example, for the requirement $?Sc(z)$ on the NP node to be satisfied, it must become the case that the variable z is involved in some scope statement at the higher $?Ty(t)$ node (e.g. $Scope(z < y)$ or $Scope(y < z)$ etc. must appear there). This ensures that the logical form derived at the end of the parse will be complete in the sense that all quantifier dependencies are explicitly encoded at the root node in the form of scope statements.

Continuing the processing of the word *man* and following the last pair of instructions in the lexical entry, after the requirement $?Sc(z)$ has been deposited on the NP node, the pointer returns to the variable node VAR. The tree remains the same except from this movement of the pointer:

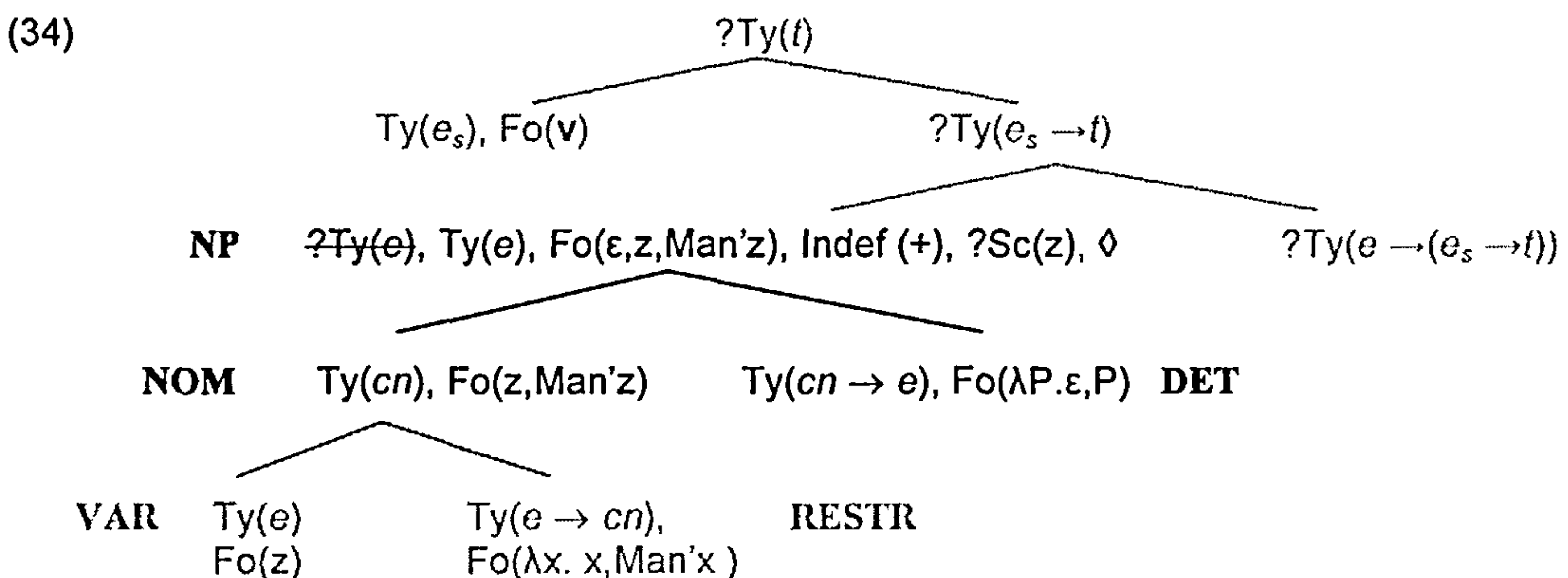


At this point, with the pointer being at the VAR node it would be possible for a restrictive relative clause to be the next input to the parsing task. In such a case, another tree would be constructed which would necessarily include a copy

of the variable z somewhere inside it. However, we will not take this option here; instead the rules of *Completion* and *Elimination* (see Chapter 2: (44), (47)) will take over in order to gradually compile the information from all daughter nodes in the NP subtree to the mother nodes. This is expected to satisfy the requirement on the NP node for a completed type e formula value which will be the indefinite epsilon term $\epsilon, x, \text{Man}'x$. In order to achieve this result, firstly, the pointer moves from the completed VAR node to its mother above. Then we can fully complete the NOM node by combining the Formula and Type values of its daughters and recording the information:



Now the highest type e node can be compiled too by applying the same rules:



With the pointer at the higher type e node we are now left with the requirement $?Sc(z)$ to be dealt with in order to complete the NP subtree. As we said previously this is a requirement for the epsilon term that has been constructed $(\epsilon, z, \text{Man}'z)$ to participate in a scope relation with the other terms

that will appear in its propositional environment. The technical means DS makes available for this to be achieved are as follows: Since the actions for processing each quantificational noun phrase necessarily introduce a fresh variable on the tree, we can assume that the quantifier itself can be provisionally represented in any scope relations by its own variable. In order to handle the idiosyncratic scope requirements of each quantificational expression in natural language (in our case the difference between *indefinites* and *non-indefinites*), DS defines rules which address the variable representative of its quantifier and establish the appropriate restrictions which will constrain how the scope dependencies of the quantificational terms on the tree should be resolved. The application of these rules relies on features that each type of quantificational determiner contributes on the NP node, in our case the feature *Indef*(+/-). The result of applying one of those rules will be that a *scope statement*, a proposition which defines some quantificational dependency, will be deposited at the most local ?Ty(*t*) node (e.g. $\text{Scope}(x < z)$ or $\text{Scope}(y < x)$ etc.).

Returning to the processing of our example sentence in (22), the presence of an indefinite noun phrase in the linguistic input has resulted in the construction of an epsilon term and in the feature *Indef*(+) to be placed at the NP node. The scope-related rule that will be invoked now is one which refers to the presence of this feature on a type *e* node where the pointer resides. The specification of this rule is as follows:

(35) **Scope action for indefinites:**

IF { *Indef*(+), ?Sc(**x**) }

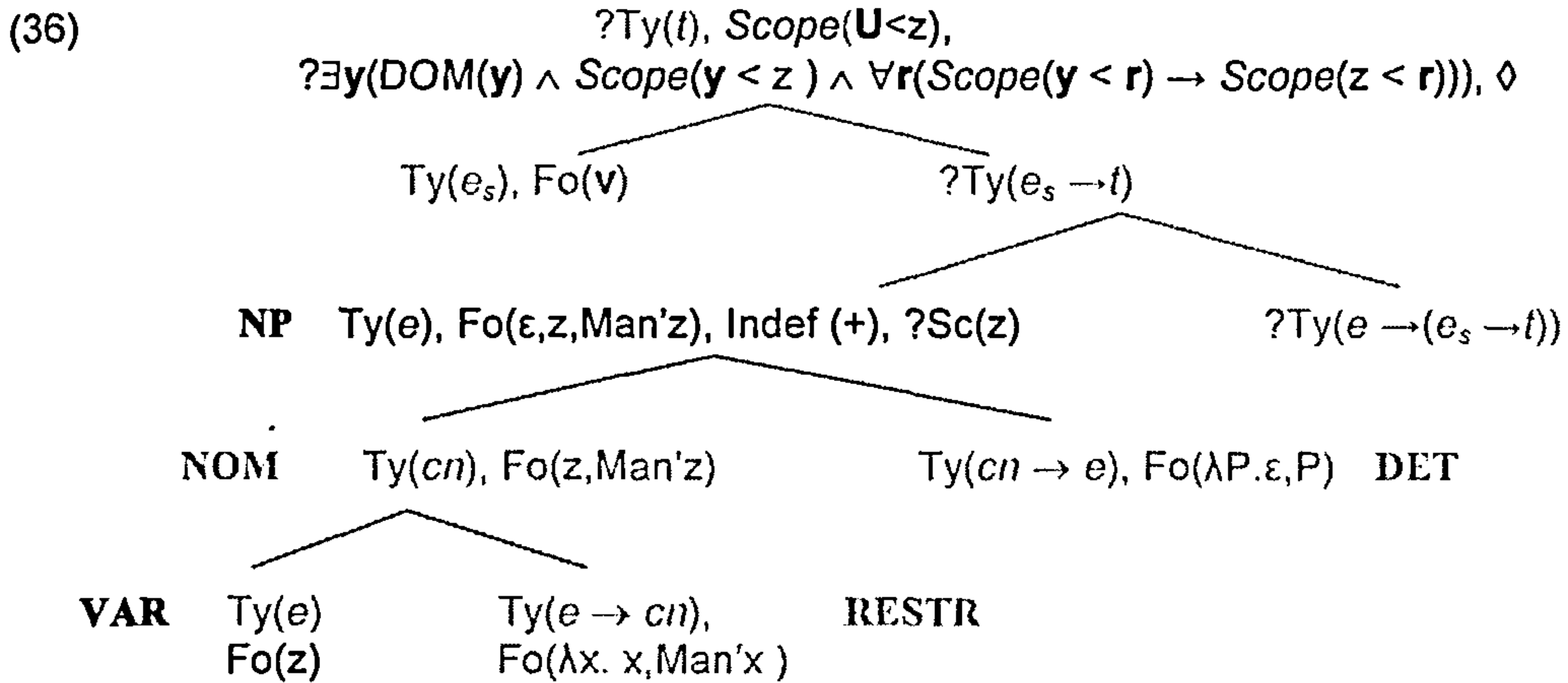
THEN $\text{gofirst}_t(\text{?Ty}(t))$;

$\text{put}(\text{Scope}(\mathbf{U} < \mathbf{x}),$
 $\text{?}\exists \mathbf{y}(\text{DOM}(\mathbf{y}) \wedge \text{Scope}(\mathbf{y} < \mathbf{x}) \wedge \forall \mathbf{r}(\text{Scope}(\mathbf{y} < \mathbf{r}) \rightarrow \text{Scope}(\mathbf{x} < \mathbf{r})))$)

ELSE abort

Let's look at the instructions the rule gives in detail. Initially there is a condition that the rule can only apply if the pointer is at a node carrying the *Indef*(+) feature and a requirement for a scope participation for some variable. Recall that as we

said above the bold variable **x** employed in the rule will be instantiated to the actual variable appearing on the node (*z* in our case) appearing in the annotation ?Sc(*z*). If this condition for the application of the rule is satisfied, as it is in our example, then there is a course of action that must be taken. Firstly, the pointer has to move to the most local dominating ?Ty(*t*) node (*gofirst*₁(?Ty(*t*))). Then a scope statement has to be introduced there according to the following instructions: Because the natural language determiner that gave rise to the term was an indefinite, there must be another element on the tree on which the epsilon term constructed from the indefinite depends for its interpretation. At this stage, we do not yet know which term this will be, as this will be resolved eventually by means of free pragmatic choice constrained by the input contributed by other elements in the linguistic string. Therefore we need to express now the fact that at some point in the future of the parse there must exist some dependency relation, symbolised by <, between two variables, as representatives of their terms. The second member of this dependency relation will be the variable currently employed in the scope requirement, in our tree, ?Sc(*z*), because the epsilon term it represents will be the dependent one. The first member of this relation will be a variable representing some other term on which the currently being constructed epsilon term will depend. However, as we said, we still do not know which variable this will eventually be. For this reason we now need to employ a metavariable to stand temporarily as the first member of the < relation. Accordingly, the *scope action* rule in (35) above, which will apply now, specifies that the statement Scope(**U** < **x**) must be put at the ?Ty(*t*) node with **x** now instantiated to an actual variable. Therefore, in our case, the annotation will take the form Scope(**U** < *z*):



Since the metavariable must be substituted by a proper formula value at some point we thus ensure that there will be a scope relation involving the variable of interest z (therefore $?Sc(z)$ on the NP node will also be satisfied). However, we need to impose some restrictions on the choice of term that will replace the metavariable \mathbf{U} . The rest of the annotation inserted above is motivated by the fact that the actual value for the metavariable just inserted must be selected from the terms that have been produced as a result of parsing the current string (that is, the value for \mathbf{U} cannot be supplied freely by the context as was the case for metavariables that have been produced by the processing of pronouns). To achieve the expression of this restriction requiring a local replacement for our metavariable, DS employs a monadic predicate symbolised as *DOM* which seeks all the $Ty(e)$ variables that are located inside the currently being constructed $Ty(t)$ structure. The predicate *DOM* is defined as follows³⁹:

$$\begin{aligned}
 (37) \quad Tn \models_M \text{DOM}(a) &\Leftrightarrow \\
 Tn \models_M ?Ty(t) \wedge [& (\downarrow \downarrow^* [Ty(e) \wedge <\downarrow_0> <\downarrow_0> \text{Fo}(a)]) \vee (<\downarrow_0> \text{Fo}(a))]
 \end{aligned}$$

The definition says that the predicate *DOM* is true of a Formula value a at a tree node if currently the pointer is on a $?Ty(t)$ node and either one of the following

³⁹ In Kempson et al (2001) where the situation argument is treated as a label there is a slightly different definition of the predicate *DOM*.

two conditions is satisfied: either (i) somewhere below dominated by the $?Ty(t)$ node there is a $Ty(e)$ node which has one argument granddaughter bearing the Formula value a , or, (ii) the daughter of the $?Ty(t)$ node has the formula value a , i.e. a is the situation argument. Thus this requirement indicates specific locations for finding values to appear in scope statements: the granddaughter of a $Ty(e)$ node is always a variable (VAR) bound by a quantificational term, therefore, the actual value of a can only be a variable somewhere inside the local tree under construction (ensured by $\downarrow\downarrow^*$) or, in the second case, the situation argument for that tree (as we will see later the situation argument might be a term or a variable itself).

Having defined DOM we can now return to the rest of the annotation introduced by the scope action rule for indefinites in (35), partially repeated below:

(38) **Scope action for indefinites:**

...

THEN

...
 put(Scope($U < x$),
 $? \exists y (DOM(y) \wedge Scope(y < x) \wedge \forall r (Scope(y < r) \rightarrow Scope(x < r)))$))

...

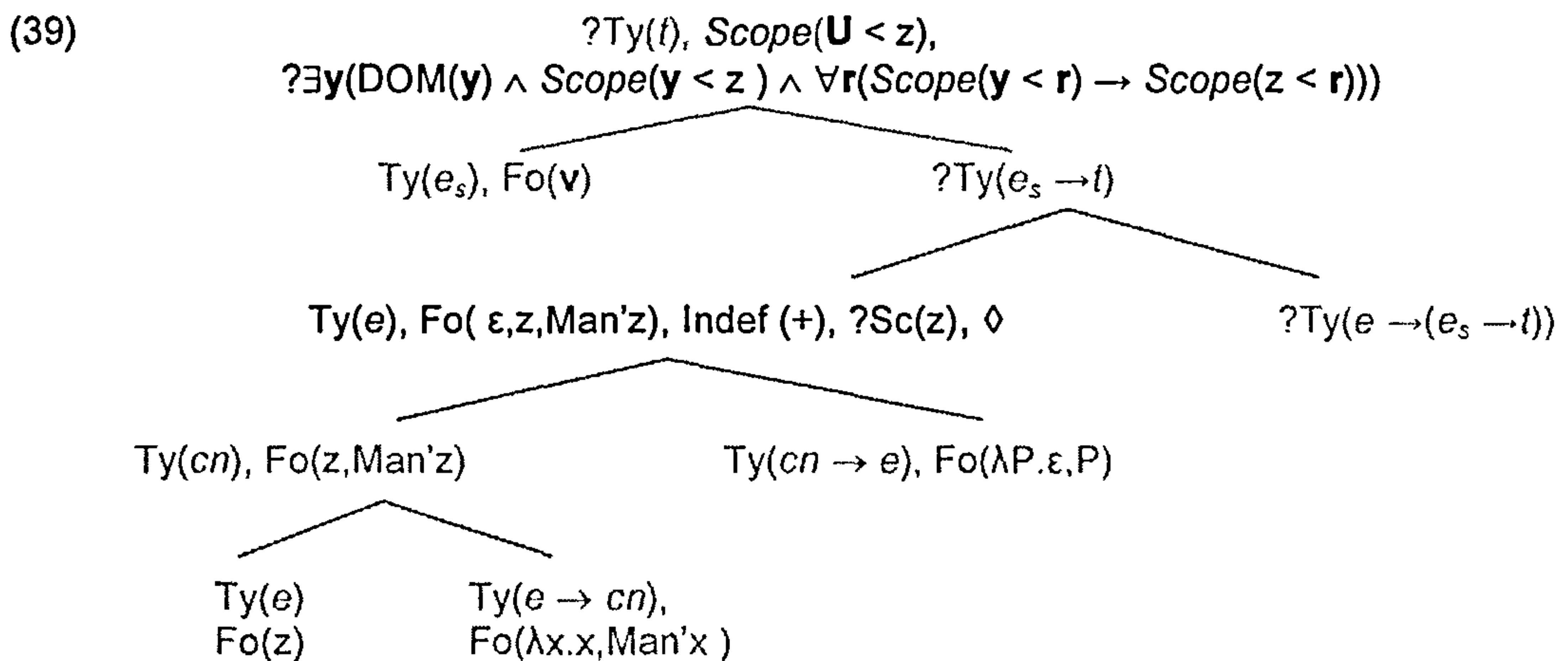
We see that the requirement deposited on the $?Ty(t)$ node states that there must be some variable instantiated to y which satisfies the *DOM* predicate (i.e. it can be found somewhere below) and which outscopes the variable of interest x (the latter instantiated to an actual value, z in our case). In most cases, the fact that U must outscope x will force the value for U and the value for the instantiation of y to be one and the same⁴⁰. The rest of the requirement states that any other variables which might previously have been outscoped by the instantiation of the variable y will now also be outscoped by the instantiation of the variable x . This

⁴⁰ The value for U could in principle have been different from the value of y but it is assumed that there will be a strict linear ordering of all variables participating in the scope statements. This makes it impossible that the value of U will not also outscope y so that x is outscoped by both, i.e. $U < y < x$.

is because we need to produce a strict linear order of variables representing terms on the tree in terms of scope relations and therefore we cannot allow undefined scope relations among them.

These are all the constraints regarding scope that can be attributed to linguistic input and the function of the DS formalism. Otherwise, the choice of which one of the variables on the tree will be the actual replacement for U is left open by the grammar and to be determined according to pragmatic factors.

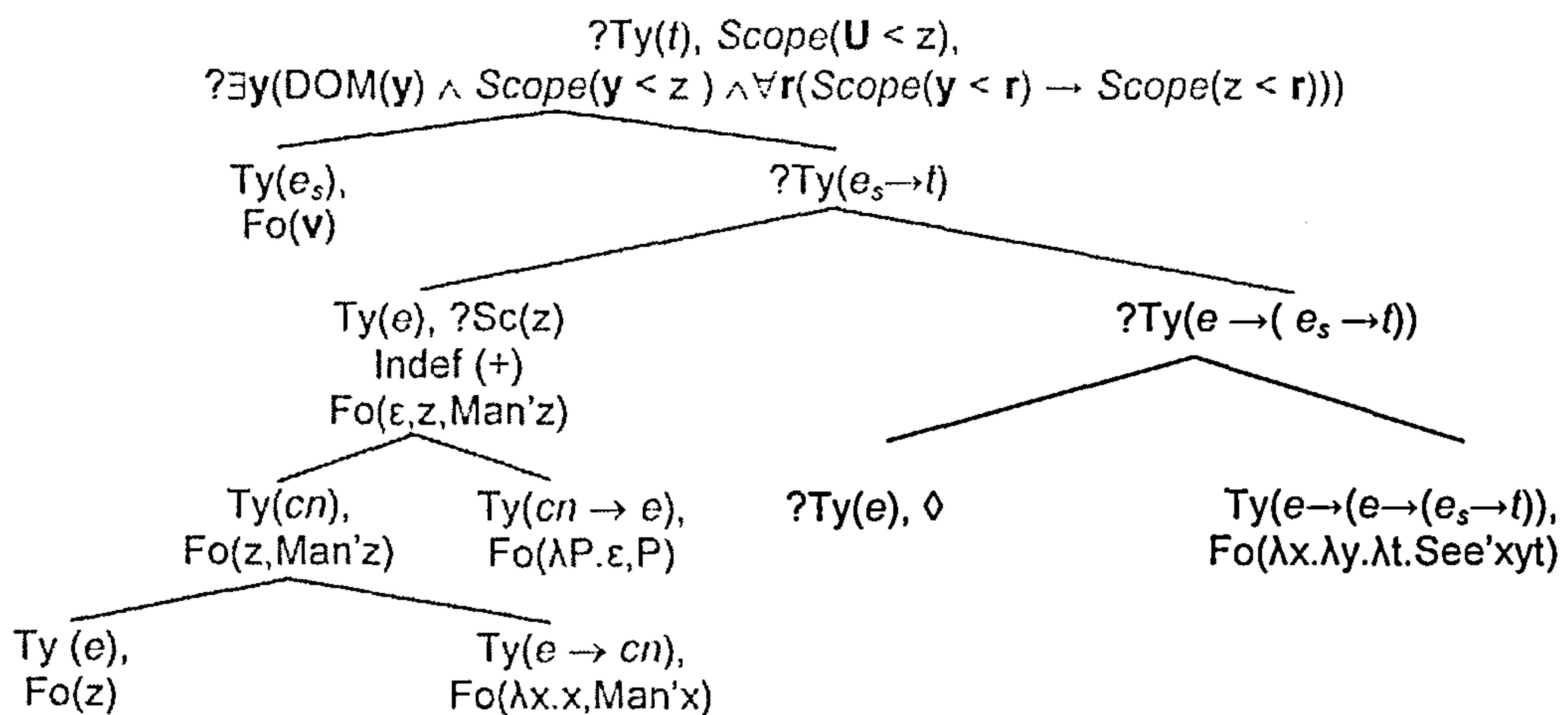
Let's then return to our example of parsing the sentence: *A man saw every girl*. As we said, the variable taken to represent the newly built epsilon term is the fresh variable z . By applying the scope action rule for indefinites (35) with respect to the variable z (i.e. by instantiating the x on the rule to the actual variable z) decorations regarding z 's scope dependencies have been deposited at the $?Ty(t)$ node. Since now there is a scope statement that involves the variable z if we had a value for it available on the tree, e.g. if the situation argument were as a substituent for it, then the requirement $?Sc(z)$ on the NP node would be satisfied and could be deleted. However we do not take this option here and leave the requirement on the node:



We then assume that this is a case where the epsilon term resulting from processing the indefinite *a man* is intended to take narrow scope with respect to all the other terms on the tree, i.e., the interpretation of the sentence *a man saw*

every girl will be that for each girl there is a separate man who saw her. In DS terms this will mean that the epsilon term $(\varepsilon, x, \text{Man}'x)$ will depend on the τ -term that will result from parsing the phrase *every girl*. However, since we still have not processed this phrase we have no choice now but delay the selection for a replacement for the metavariable **U** and continue with the parse hoping that an appropriate replacement will be found in due course. (Of course the choice is open to select the situation argument as a replacement but let's assume here that this option were not taken since this would give wide scope to the ε -term). By the usual processes, the pointer now moves, in due course reaching the predicate node decorated with $?Ty(e \rightarrow (e_s \rightarrow t))$. While there, parsing of the verb *saw* leaves the tree as follows (we are not dealing now with the parsing of the tense specification which presumably will substitute the metavariable on the $Ty(e_s)$ node with an actual variable v or some epsilon or tau term retrieved from context):

(40)



Now the pointer awaits on a node requiring input of type e . Parsing of the phrase *every girl* is expected to provide such input. The gradual construction of this $?Ty(e)$ node will go on in a similar way as with the indefinite above with only a few differences owing to the fact that we are now processing a strong (non-indefinite) quantifier. The lexical entry for *every* is as follows:

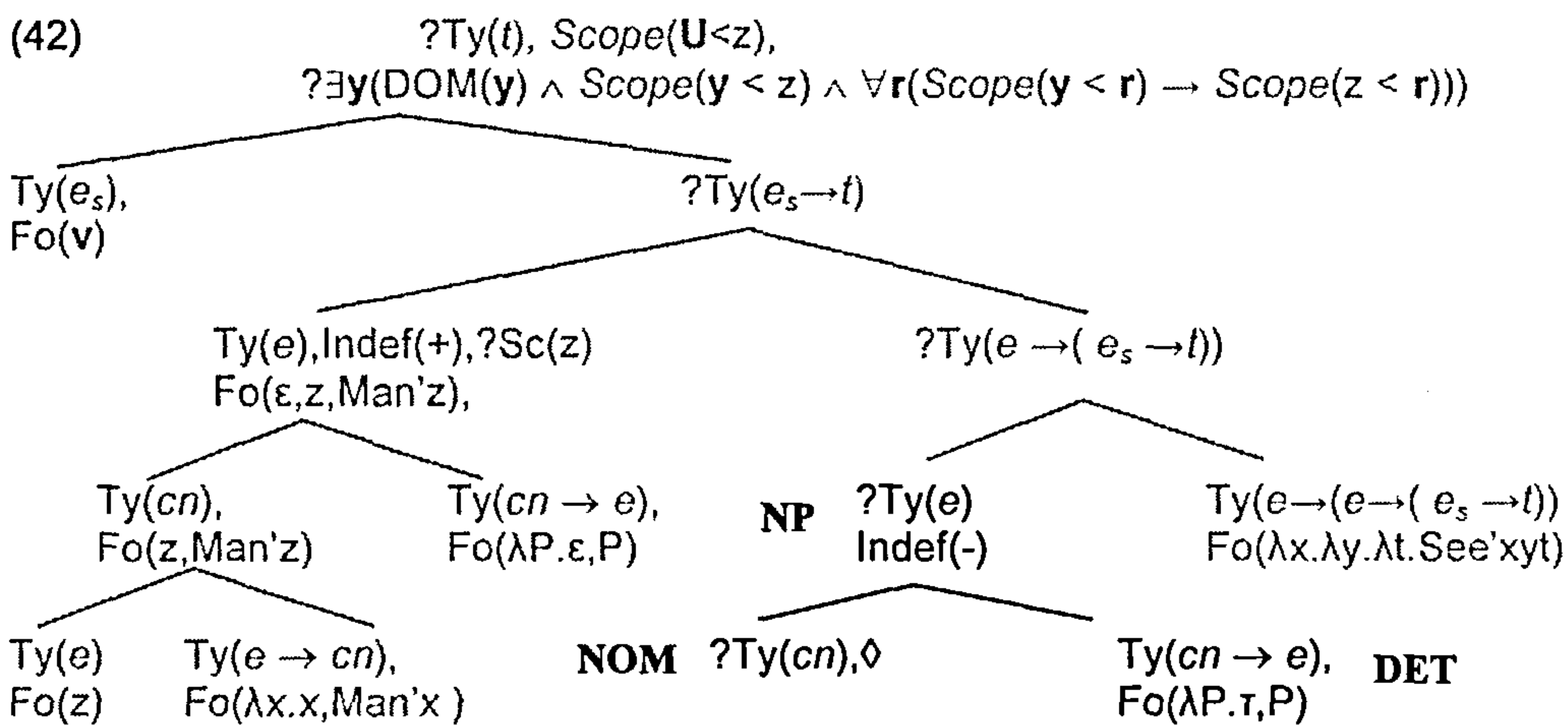
(41) **every:**

IF $?Ty(e)$

THEN $put(Indef(-)); make(<\downarrow_1>); go(<\downarrow_1>); put(Fo(\lambda P.\tau, P), Ty(cn \rightarrow e));$
 $go(<\uparrow_1>); make(<\downarrow_0>); go(<\downarrow_0>); put(?Ty(cn))$

ELSE abort

The only difference with the lexical entry of the determiner *a* is that a formula value involving the term binder τ is introduced and the feature *Indef(-)* is deposited on the top type e node. The latter will have consequences for the type of scope action that will apply regarding this node:



We go on with the processing of the lexical item *girl* which has an entry identical to that of *man* except that the concept *Girl'* is introduced as formula value:

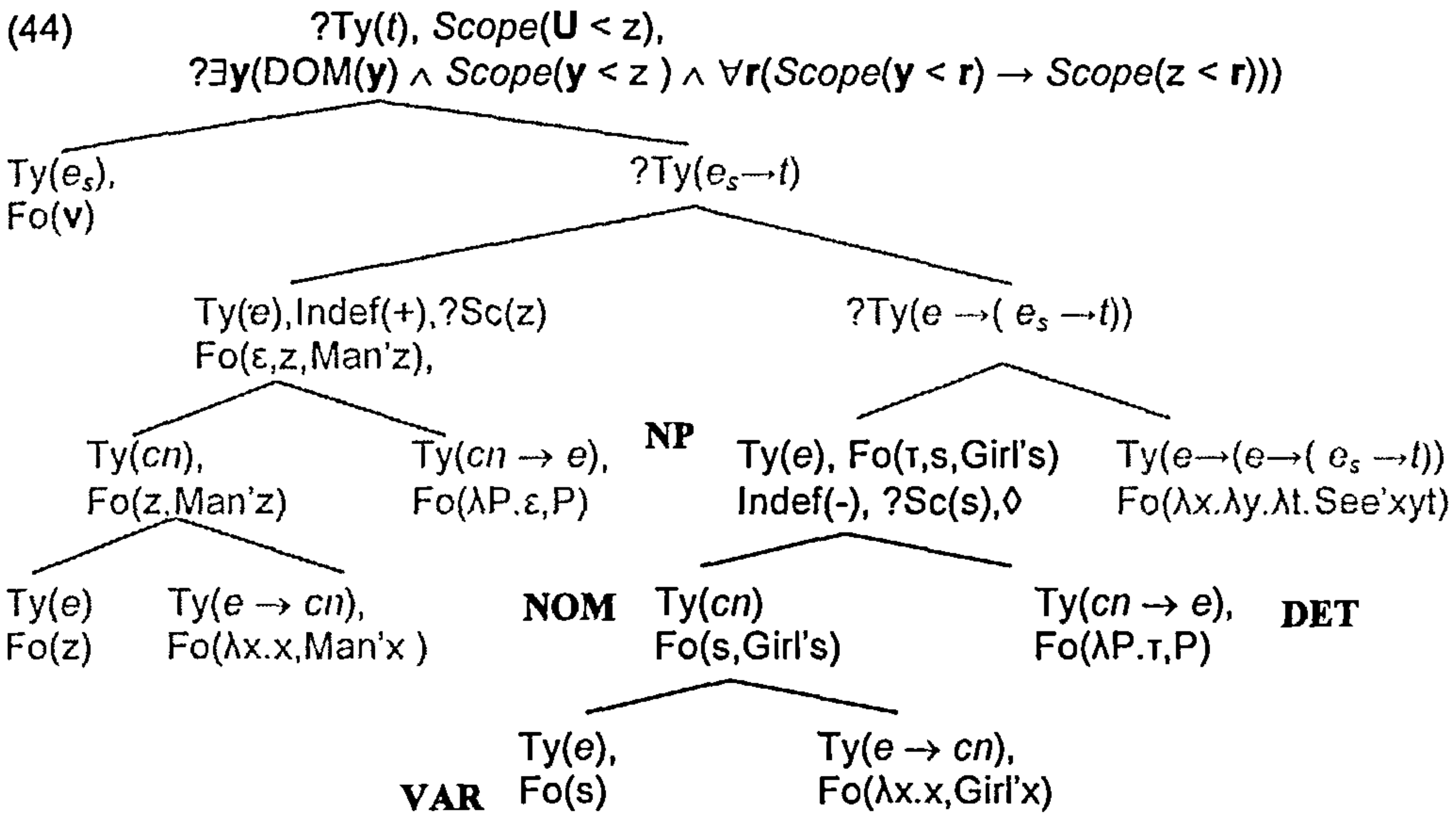
(43) **girl:**

IF $\{ ?Ty(cn) \}$

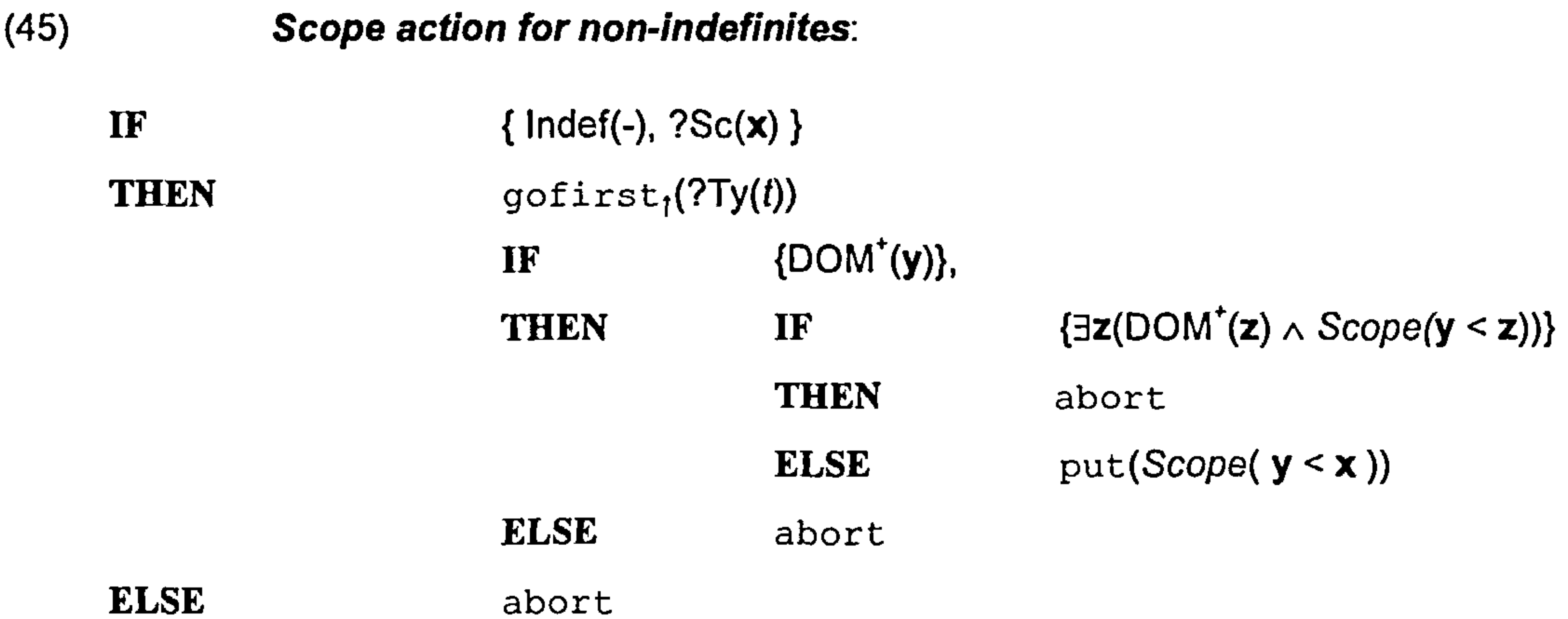
THEN $make(<\downarrow_1>); go(<\downarrow_1>); put(Fo(\lambda x.x. Girl'x)), Ty(e \rightarrow cn);$
 $go(<\uparrow_1>); make(<\downarrow_0>); go(<\downarrow_0>); freshput(x, Fo(x)); put(Ty(e));$
 $go(<\uparrow_0>); go(<\uparrow_0>) put(?Sc(x)); go(<\downarrow_0>); go(<\downarrow_0>).$

ELSE abort

After executing these actions and compiling the information on the higher type e node in the same way as previously, the tree should look as follows:



Now it is time again for the scope action rule to apply in order to be able to satisfy the requirement $?Sc(s)$ at the NP node. This time though it will be a rule suitable to a term resulting from the parsing of a strong quantifier. The appropriate rule is the following:



This rule firstly checks for the presence of the *Indef*(-) feature on the pointed node and for a requirement for a scope statement involving an actual variable which will instantiate x in the rule. In our case the variable s on the NP node will be an appropriate instantiation for x and the feature *Indef*(-) is indeed found on

the same node. Following these instructions the pointer moves to the most local dominating $?Ty(t)$ node ($gofirst_1(?Ty(t))$). From there a search will be performed of all the dominated variables on the tree this time employing the predicate DOM^+ which is defined as follows:

$$(46) \quad T_n \models_M DOM^+(a) \Leftrightarrow \\ T_n \models_M ?Ty(t) \wedge [(\downarrow \downarrow^* [Indef(-) \wedge \langle \downarrow_0 \rangle \langle \downarrow_0 \rangle Fo(a)]) \vee (\langle \downarrow_0 \rangle Fo(a))]$$

The definition says that a formula value a , a variable in our case, satisfies the predicate DOM^+ if the pointer is currently at a $?Ty(t)$ node and either one of these two conditions hold: either there is a node somewhere below which bears the feature $Indef(-)$ and has an argument granddaughter (VAR) with formula value a or, alternatively, the formula value a appears on the node bearing the situation argument. Let's now return to the scope action for non-indefinites rule (45) partially repeated again below and see what purpose the definition of DOM^+ serves:

(47) **Scope action for non-indefinites:**

...

IF	$\{DOM^+(y)\},$
THEN	IF $\{ \exists z(DOM^+(z) \wedge Scope(y < z)) \}$
	THEN abort
	ELSE put($Scope(y < x)$)
ELSE	abort

...

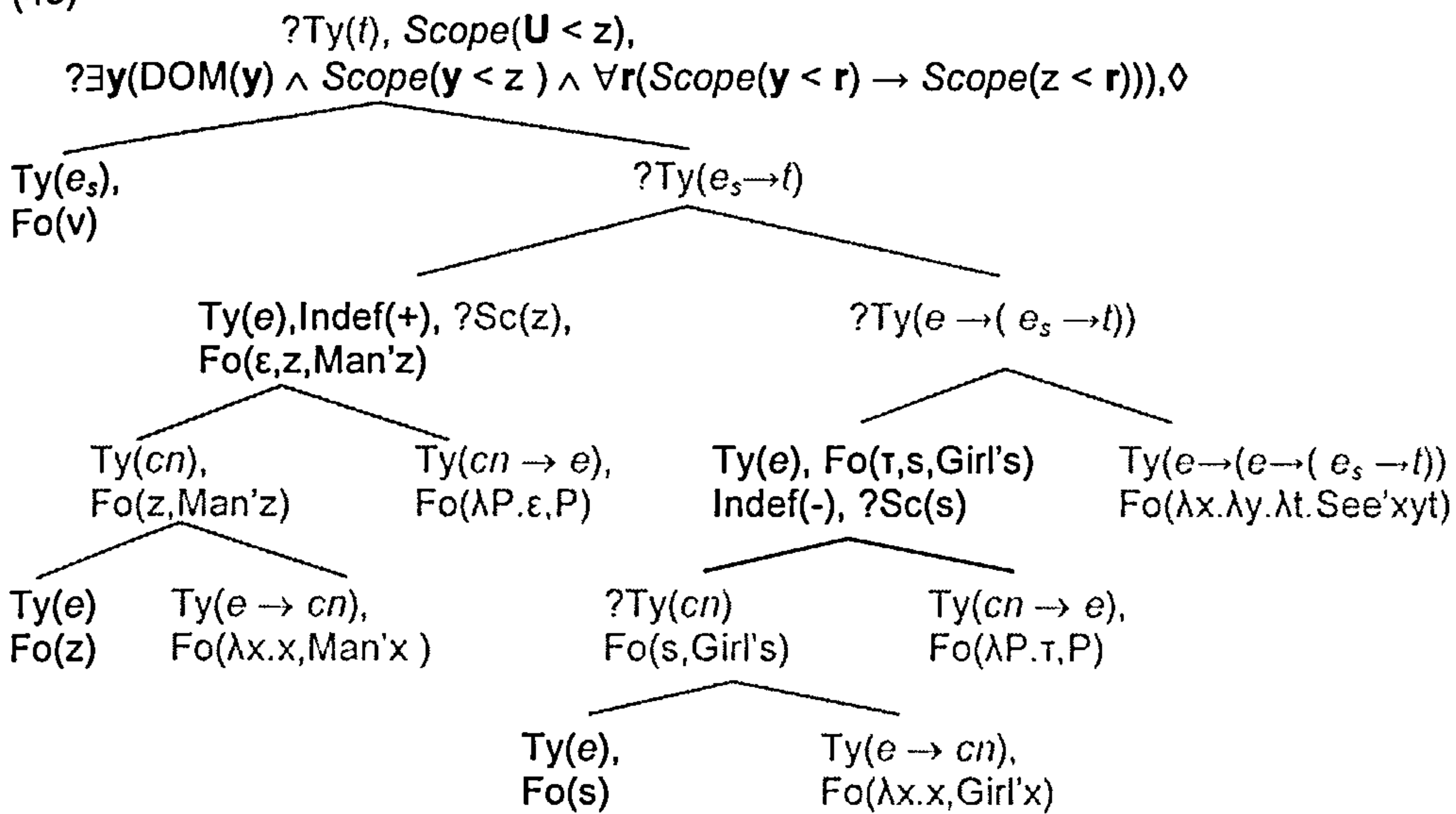
The condition on the application of the rule: **IF** $DOM^+(y)$ which employs the bold variable y allows its instantiation to any variable on the tree that has been contributed by an non-indefinite ($Indef(-)$) quantificational expression. To illustrate the function of the rule, let's suppose for a moment that the $Indef(-)$ variable r were found somewhere below on the tree and that we instantiate the y on the rule to r . Now we have $DOM^+(r)$ being true. According to the third condition on the rule: **IF** $\exists z(DOM^+(z) \wedge Scope(y < z))$, we must now check if there is another $Indef(-)$ variable on the tree which depends on r , i.e. check if

$Scope(r < z)$ is true. If one such variable is found then the process aborts. This is because, in the DS framework, quantificational expressions which contribute the *Indef(-)* feature are assumed to acquire scope analogous to their order of presentation with the most recently introduced terms taking more narrow scope. It is only indefinites which can overrule this restriction. Therefore, if there is a *Indef(-)* variable which has narrow scope with respect to r , then this variable must have been introduced *after* the processing of the quantificational phrase that gave rise to r . The variable we need to instantiate y to is the most recently introduced *Indef(-)* variable and for this reason r will not do. By aborting the process another instantiation of y can take place since we have the requirement $?Sc(x)$, with x instantiated to some actual variable, to satisfy. We see therefore that the *Scope action rule* in effect initiates a search for the most recently introduced variable that has not been contributed by an indefinite. This is achieved by selecting different variables as instantiations for y . Suppose that this process is successful and we manage to find the variable most recently introduced by a non-indefinite quantifier. As soon as this variable is found the rule allows us to introduce a scope statement which indicates that the newly discovered variable has wider scope than the instantiation of x , the newly introduced variable of interest ($Scope(y < x)$). The result of this is that the term currently being constructed employing the instantiation of x has narrow scope with respect to the most recently introduced non-indefinite term employing the instantiation of y and as a further consequence it has also narrow scope with respect any other previously introduced non-indefinite terms as well. This is because, as we said before, we have assumed that strong quantifiers display scope dependencies that respect their order of introduction to the tree (disregarding terms contributed by indefinites). The scope action rule for non-indefinites ensures this for all cases.

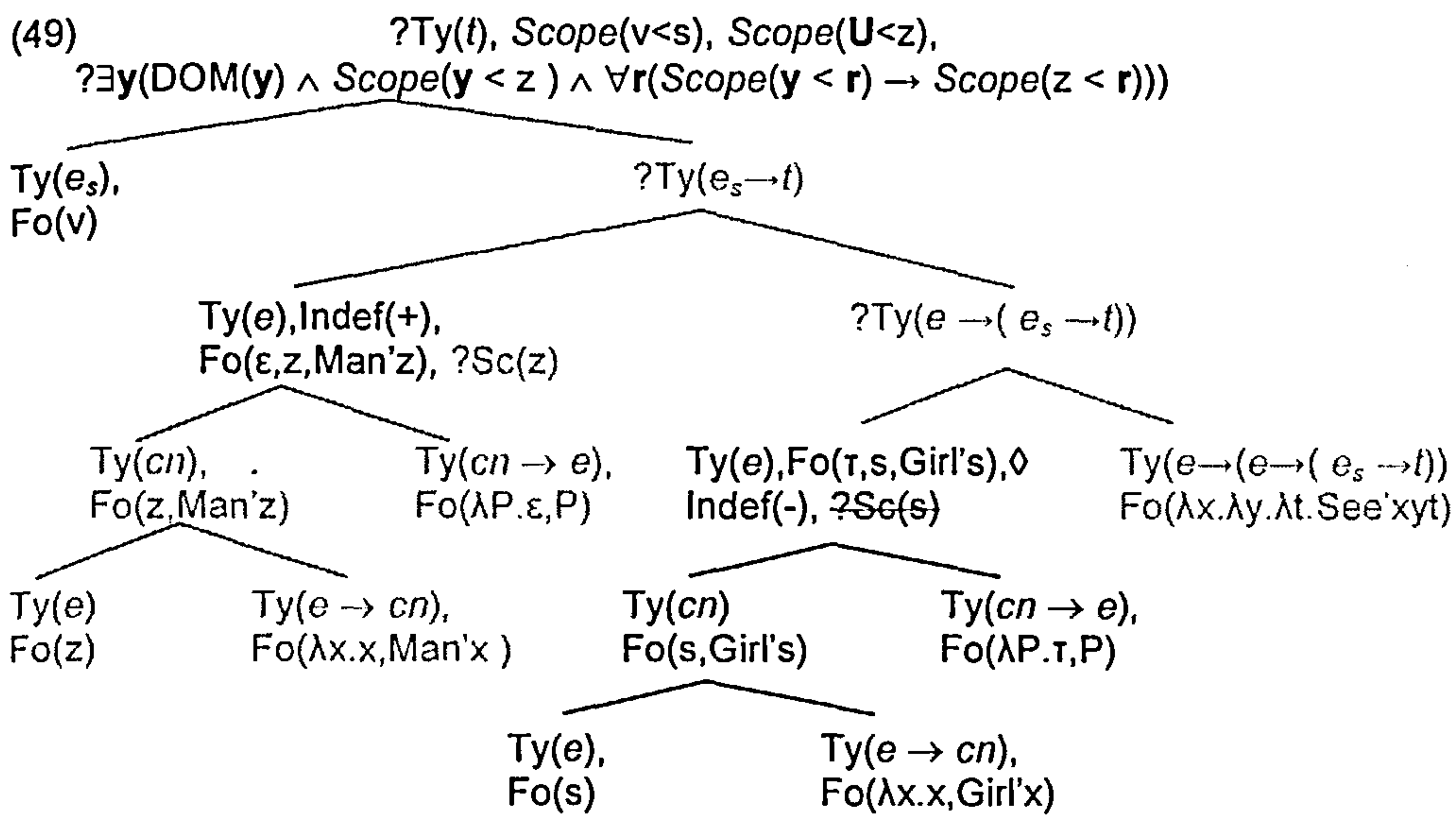
Let's now leave the digression and return to the process of parsing our example at the stage where we attempt to satisfy the requirement for a scope statement: $?Sc(s)$. The first condition of the *Scope Action for Non-indefinites* rule has been satisfied, that is, we have instantiated the x in the rule (45) to s , the

pointer has moved upwards to the most local $?Ty(t)$ node and we are now searching for a variable for s to depend on:

(48)



It can now be seen that the search initiated by the *Scope Action for Non-indefinites rule* will in fact yield no variable which was most recently introduced by a strong non-indefinite quantifier since the only other quantificational expression processed was the indefinite *a man*. Therefore according to the definition of DOM^+ only the situation argument v can now be taken as having wider scope than s (as we said the variable contributed by the indefinite *a man* does not count for DOM^+). By placing on the top of the tree the proposition $\text{Scope}(v < s)$, the requirement $?Sc(s)$ will be satisfied and can be deleted. Now the tree looks as follows:



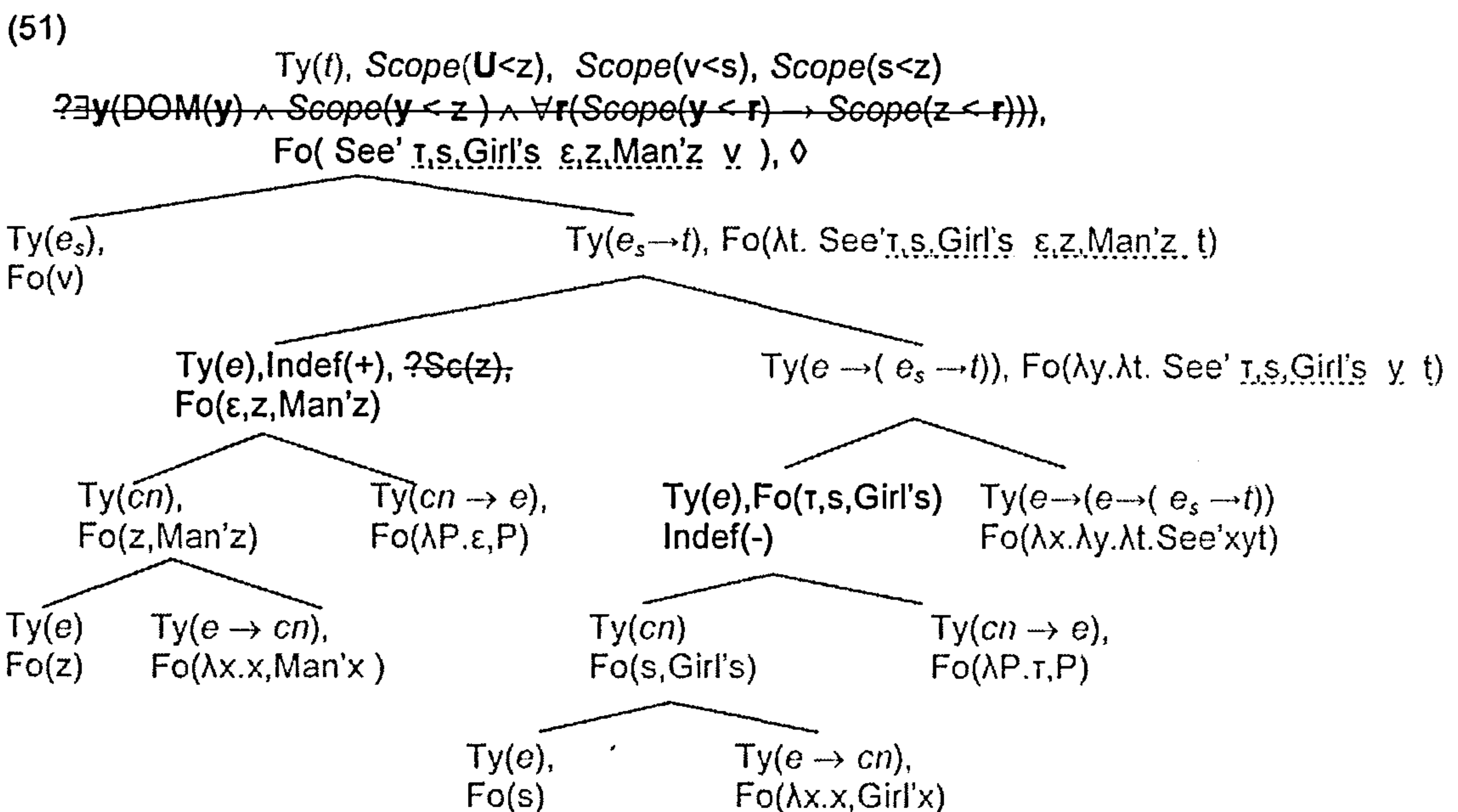
Since there is no more linguistic input to be processed, the rules of Completion and Elimination apply as usual and complete the tree. Since there are no other quantificational terms to be parsed, a decision must now be made regarding the metavariable \mathbf{U} which is the first member of the relation $<$ involving the variable z contributed by the indefinite *a man*. Suppose that we decided to substitute \mathbf{U} by v as it is indeed possible in principle given that this choice is a free pragmatic one. We now have to check whether the requirement $\text{?}\exists y(\text{DOM}(y) \wedge \text{Scope}(y < z) \wedge \forall r(\text{Scope}(y < r) \rightarrow \text{Scope}(z < r)))$ can be satisfied. First of all, we have to find a formula value that satisfies *DOM* which according to the definition in (37) repeated below means that it is either a variable inside an epsilon or tau term subtree or the situation argument:

$$(50) \quad T_n \models_M \text{DOM}(a) \Leftrightarrow$$

$$T_n \models_M \text{?Ty}(t) \wedge [(\downarrow \downarrow \cdot [(\text{Ty}(e) \wedge \langle \downarrow_0 \rangle \langle \downarrow_0 \rangle \text{Fo}(a))]) \vee (\langle \downarrow_0 \rangle \text{Fo}(a))]$$

Let's instantiate y in the requirement at the top node to the situation argument v which clearly satisfies *DOM*(v). The requirement also contains the conjunct $\forall r(\text{Scope}(y < r) \rightarrow \text{Scope}(z < r))$ which with y instantiated to v now says that whatever variables were already outscoped by the situation v will now be also outscoped by the variable z : $\forall r. \text{Scope}(v < r) \rightarrow \text{Scope}(z < r)$. The annotation already present on the $\text{?Ty}(t)$ node states that v outscopes the variable s :

$\text{Scope}(v < s)$. Therefore if we choose to substitute the metavariable \mathbf{U} by v then we will be obliged to also take the quantifier contributed by the indefinite *a man* as having wide scope with respect to the quantifier contributed by the phrase *every girl*. This is a possibility but it will not ensue in the intended interpretation here as what we wanted to achieve was that the choice of man should vary according to the choice of girl, i.e. we wanted the term $\varepsilon, z, \text{Man}'z$ to have narrow scope with respect to $\tau, s, \text{Girl}'s$. For this reason the only option available to us is the substitution of the metavariable \mathbf{U} by the variable s . Now the statement $\text{Scope}(s < z)$ replaces the statement $\text{Scope}(\mathbf{U} < z)$ on the $?Ty(t)$ node and the requirement $?Sc(z)$ has been satisfied:



The requirement $? \exists y(\text{DOM}(y) \wedge \text{Scope}(y < z) \wedge \forall r(\text{Scope}(y < r) \rightarrow \text{Scope}(z < r)))$ with y instantiated to s is satisfied because there is a variable, namely s , that is dominated by the $?Ty(t)$ node, it outscopes z and also satisfies trivially the requirement that all the variables that it outscopes are also outscoped by z ⁴¹. Therefore we derive the result: $\text{Scope}(v < s < z)$.

⁴¹ Note that the relation $<$ is transitive and irreflexive and therefore $z < z$ is by definition not allowed. On the other hand the facts $v < s$ and $s < z$ imply that $v < z$ and therefore $v < s < z$ which is how we annotate the scope statement for brevity: $\text{Scope}(v < s < z)$.

Since the parsing of the string has been completed it is now time to present how the quantifier evaluation rule by repeated application restructures the formula value at the top of the tree in such a way that the significance of the scope statement $s < z$ will be incorporated explicitly in the formula annotation (for simplicity we will ignore the situation argument here). The computational rule named *Q-Evaluation* is responsible for performing the requisite actions⁴²:

(52) **Q-Evaluation Rule:**

$$\frac{\{ \dots \{ \text{Ty}(t), \dots, \text{Scope}(x_1 < \dots < x_n), \text{Fo}(\varphi[v \ x_n \ \psi_n/x_n]) \dots \} \}}{\{ \dots \{ \text{Ty}(t), \dots, \text{Scope}(x_1 < \dots < x_{n-1}), \text{Fo}(f_{v_n, x_n \ \psi_n}(\varphi)), \dots \} \}}$$

where for x occurring free in φ , the values $f_{v_n x_n \psi_n}(\varphi)$, for $v \in \{\epsilon, \tau, Q\}$ are defined by:

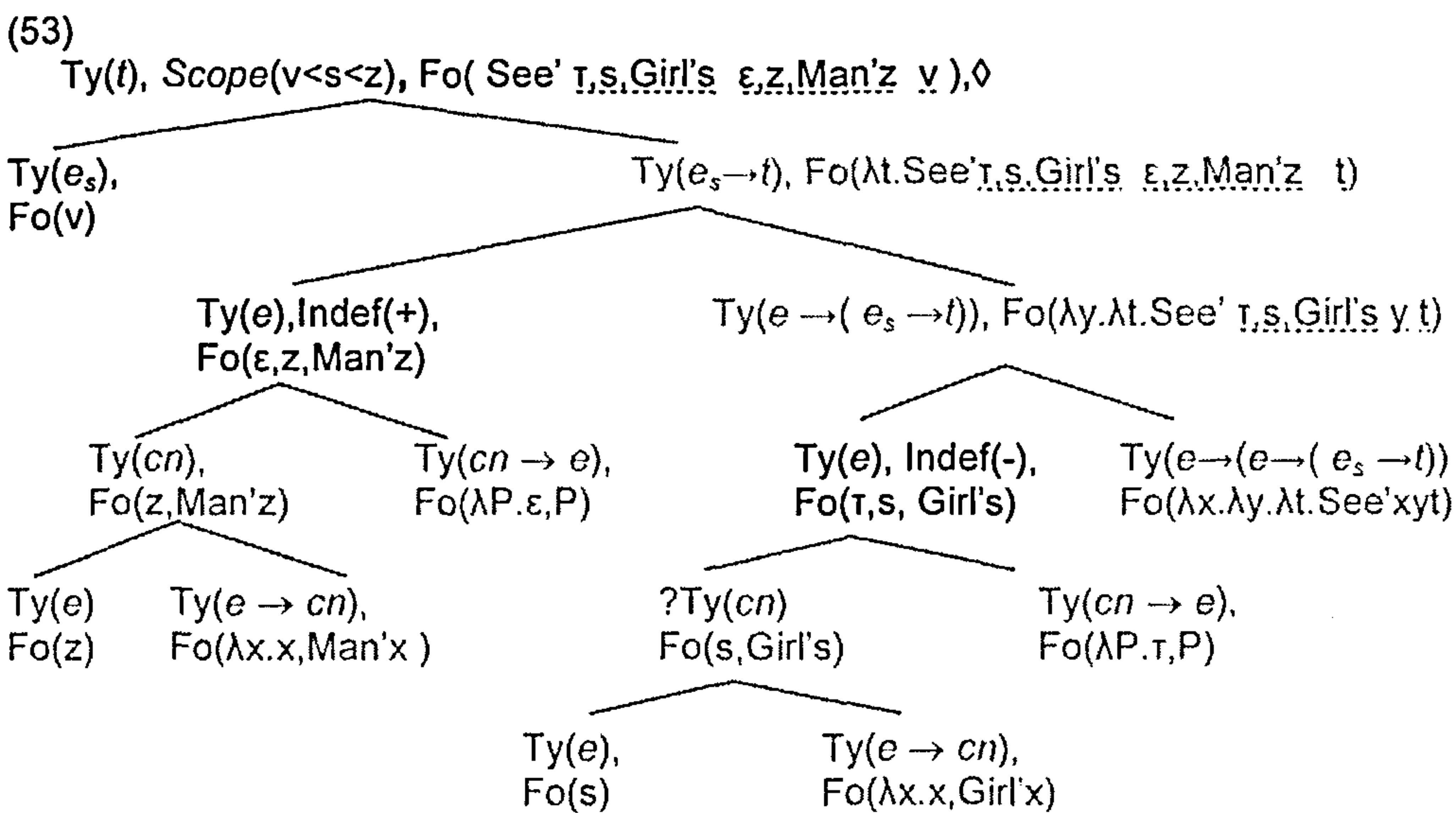
- (a) $f_{\tau, x, \psi}(\varphi) = \psi[a/x] \rightarrow \varphi[a/x]$
where $a = \tau \ x \ (\psi \rightarrow \varphi)$
- (b) $f_{\epsilon, x, \psi}(\varphi) = \psi[b/x] \wedge \varphi[b/x]$
where $b = \epsilon \ x \ (\psi \wedge \varphi)$
- (c) $f_{Q, x, \psi}(\varphi) = (\psi[c/x]) (\varphi[c/x])$
where $c = v_Q x ((\psi)(\varphi))$.

The rule takes as its input the scope statement containing a (strictly) ordered sequence of variables, $\text{Scope}(x_1 < \dots < x_n)$, and the formula at the type t node of the tree symbolised here as φ . The formula contains epsilon and tau terms binding the variables appearing in the scope statement. The term inside the formula that binds the rightmost variable x_n in the scope statement is indicated here as $v \ x_n \ \psi_n$. The definition of the rule (above the line) indicates that all occurrences of this term are to be removed and replaced by the variable x_n . The new formula constructed in this way, indicated as φ in the rule, will now be transformed by applying to it a function appropriate for the type of operator binding the variable. The transformation consists in introducing connectives, \wedge , \rightarrow , etc. appropriate to the quantificational force implicit in the term and replacement of the free variable x_n inside φ by complex terms abbreviated as a , b , c etc.. These complex terms record in their structure all the information that

⁴² We differ here from both Kempson et al. (2001) and Cann et. al. (2005) in that we present the Q- Evaluation Rule as an update of tree descriptions. The rule will be modified in Chapter 4 to take into account the world and situation argument.

makes explicit the scope relations among them. The rule applies repeatedly, each time focusing on the rightmost variable in the sequence until all variables in the scope statement have been consumed and the initial formula has been transformed.

Let's now apply this rule to the formula derived at the root of the tree in (51) shown completed below (we assume that the situation variable v remains free in the formula since it is not bound inside any term, for more extensive discussion and modifications see Chapters 4, 8)⁴³:



The formula that we wish to apply the *Q-evaluation* rule on is (disregarding the situation argument): $\text{See}'(\epsilon, z, \text{Man}')(\tau, s, \text{Girl's})$; This will now be transformed to match the formula specification φ in the rule. The scope statement that will guide the transformation is: $\text{Scope}(s < z)$. Since the variable z has narrow scope with respect to s , i.e. is shown as the rightmost element in the sequence, according to the rule, we must start with the epsilon term in which it is bound. So firstly we replace all the occurrences of the term $(\epsilon, z, \text{Man}'z)$ with its variable z which now occurs free in the formula. This gives us the following formula (all changes on the formula will be highlighted with shading from now on):

(54) $\text{See}'(z)(\tau, s, \text{Girl's}). \text{Scope}(s < z)$

⁴³ Again we employ dotted underlining instead of brackets for readability purposes.

This formula now matches φ in the *Q-evaluation* rule (52) above. We now apply to this formula the function which is appropriate for an epsilon term $(f_{\varepsilon, x, \psi})$. In the present case, ψ will be the restrictor of the epsilon term, i.e., $Man'z$. According to the rule in (52), we are required to apply $f_{\varepsilon, z, Man'z}$ to φ , i.e., in our case, $See' z \tau, s, Girl's$, which gives us: $f_{\varepsilon, z, Man'z} (See' z \tau, s, Girl's)$. The result of this operation is as follows:

$$(55) \quad (Man'b) \wedge (See' b \tau, s, Girl's) \quad \text{Scope}(s < z)$$

$$\text{where } b = \varepsilon, z, (Man'z \wedge See' z \tau, s, Girl's)$$

The symbol b in the formula is just an abbreviation of the epsilon term that records the entire formula in its restrictor. The same formula can also be presented without the abbreviatory name as follows:

(56)

$$Man' \varepsilon, z, Man'z \wedge See' (z)(\tau, s, Girl') \wedge See' \varepsilon, z, Man'z \wedge See' (z)(\tau, s, Girl's) \tau, s, Girl's$$

We will only use formulas like the one in (55) above containing the abbreviatory names but it must be born in mind, especially when performing substitutions, that these names really stand for the more complicated representations.

The formula in (55) or (56) is what we get after we've dealt with one of the variables in the scope statement, the one associated with the epsilon term. Now since we still have one more variable remaining in the scope statement, namely the variable s , we have to apply the *Q-Evaluation* rule once more. The input to this rule is the formula in (56) above. Following the instructions in the rule we first replace all occurrences of the term $\tau, s, Girl's$ inside the formula in (56) with its variable s . Note that we must also replace the τ -term occurring inside the name b with the variable s . The new name that results from this replacement now takes the updated name, b_s , since it contains a free occurrence of s :

$$(57) \quad Man'b_s \wedge See'b_s s \quad \text{Scope}(s)$$

$$\text{where } b_s = \varepsilon, z, (Man'z \wedge See' z s)$$

Now we can take the formula in (57) as our φ in applying the *Q-Evaluation Rule* (52). To this formula we have to apply the function appropriate for dealing with tau-terms: $f_{\tau, x, \psi}$. In our case we will have as the value for ψ , the restrictor of the original τ -term, therefore: $f_{\tau, s, \text{Girl's}}$. The result of applying this function to (57) gives us a new formula where the connective \rightarrow has been inserted and a new name, a , has replaced all previous occurrences of s (even inside the term b_s):

$$(58) \quad \text{Girl}' a \rightarrow [\text{Man}' b_a \wedge \text{See}' b_a, a]$$

$$\text{where } b_a = \epsilon, z, (\text{Man}' z \wedge \text{See}' z, a)$$

$$\text{where } a = \tau, s, (\text{Girl}' s \rightarrow [\text{Man}' b_s \wedge \text{See}' b_s, s])$$

$$\text{where } b_s = \epsilon, z, (\text{Man}' z \wedge \text{See}' z, s)$$

The name a stands for the reconstruction of the original τ -term. Additionally by substituting a for all occurrences of s , another name, b_a , has also been derived from b_s which now stands for the original ϵ -term and which shows explicitly its dependency on the term a by bearing it as a subscript. In DS this is the way that scope dependencies are shown on the final product of the parsing: the term with wider scope occurs as a sub-term inside the term which depends on it. Now let's briefly see how the transformation of the formula would have looked like if the scope relations between the two terms had been the other way round. The following would be the appropriate step-by-step reconstruction:

$$(59) \quad \text{See}' (\epsilon, z, \text{Man}' z) (\tau, s, \text{Girl}' s) \quad \text{Scope}(z < s)$$

$$(60) \quad \text{See}' (\epsilon, z, \text{Man}' z) (s) \quad \text{Scope}(z)$$

$$(61) \quad \text{Girl}' a \rightarrow \text{See}' (\epsilon, z, \text{Man}' z) (a)$$

$$\text{where } a = \tau, s, (\text{Girl}' s \rightarrow \text{See}' \epsilon, z, \text{Man}' z, s) \quad \text{Scope}(z)$$

$$(62) \quad \text{Girl}' a_z \rightarrow \text{See}' z, a_z \quad \text{where } a_z = \tau, s, (\text{Girl}' s \rightarrow \text{See}' z, s)$$

$$(63) \quad \text{Man}' b \wedge [\text{Girl}' a_b \rightarrow \text{See}' b, a_b] \quad \text{where } a_b = \tau, s, (\text{Girl}' s \rightarrow \text{See}' b, s)$$

$$\text{where } b = \epsilon, z, (\text{Man}' z \wedge [\text{Girl}' a_z \rightarrow \text{See}' z, a_z])$$

$$\text{where } a_z = \tau, s, (\text{Girl}' s \rightarrow \text{See}' z, s)$$

Here, because it is assumed that the term $\epsilon, z, \text{Man}' z$ has wider scope, namely $\text{Scope}(z < s)$, the name b that ensues after the transformation of the formula occurs as a sub-term inside the name a which has been derived by the narrower scoping term $\tau, s, \text{Girl}' s$.

We have now concluded the presentation of how the main DS processing mechanisms for constructing trees operate. In addition we have just seen how quantification is treated in a dynamic way. In the next chapter we will see how the framework is extended in order to deal with the processing of strings requiring as representations trees built in tandem.

CHAPTER 4

LINK STRUCTURES IN DS

1. Context in processing

A central motivation for the development of DS is the formal modelling of the self-evident fact that sequences of words are crucially processed inside the surrounding linguistic and extra-linguistic context. As a result, a basic assumption underlying the DS design is that extraction of information from a string of words can only be achieved through the interaction of the architecture constitutive of the parser and the context of processing. As we have seen already, the DS toolkit provides the means for parsing strings which provide minimal predicate-argument structures. Here the interaction with context consists in the fact that these structures can only be built up in conjunction with extra-grammatical processes (*pragmatic actions*) which in due course resolve underspecified information provided by the parser. The underspecification of information that we have seen is (a) underspecified content, e.g., the input that anaphoric expressions like pronouns provide, and, (b) underspecified structural information seen, e.g., in the intermediate tree representations that result from the processing of left-dislocated elements. The resolution of both these types of underspecification is treated in DS as “grammaticised”⁴⁴ in that the weak input provided by parsing the string comes with requirements for its obligatory enrichment⁴⁵: If parsing of a string of words results in the construction of an unfixed node, the string will be *ungrammatical/unsuccessful* unless the unfixed node finds a proper place in the semantic tree. Similarly an anaphoric expression introduces a requirement that a replacement must be found at some point for the metavariable that it contributes in the representation; therefore, according to

⁴⁴ The term “grammaticized” comes from von Stechow (1994) although there it is used under distinct syntactic assumptions. It is also intentionally used here to approximate the notion of “grammaticalisation” in the philological and functional/typological literature (see e.g. Meillet 1912, Hopper & Traugott 1993).

⁴⁵ This contrasts with other general forms of enrichment which cannot be assumed to be encoded as part of the grammar, e.g. *ad hoc* concept construction (see Carston 1998, 2002).

DS, a string that is parsed in a context that provides no terms for the replacement of the metavariables in its semantic representation will also be declared ungrammatical by the formalism representing the grammar since the parsing process will abort (unless repair strategies can be invoked to modify the context).

Thus the DS design provides a rule-governed interface with the extant context of processing. However, under the Relevance theoretic assumptions espoused by DS, the context appropriate for recovering an interpretation can also be constructed on the fly. Under the assumption that there is an infinite number of interpretations that can be assigned to a linguistic string, i.e. there is inherent underspecification of content by linguistic elements, the role of an appropriate context supporting processing is maximised. Moreover, given that the speaker is responsible for providing the hearer with the best chance for recovering the intended meaning of his/her utterance, a processing framework must provide formal acknowledgement of the fact that sometimes the speaker will explicitly make salient information which is particularly relevant for the recovery of the intended interpretation of the main assertion⁴⁶ and will attempt to make explicit how pieces of information are correlated with each other. The inevitability of this process of context construction and interaction necessitates the availability of hard-wired mechanisms which allow the speaker to encode the specific correlation of information presented. These mechanisms must be captured by a grammar formalism. The discussion that follows concerns how DS models this process.

⁴⁶ Of course *assertion* is only one of the message types that can be encoded through the use of a main clause; we limit ourselves to those for simplicity. And it is the case that e.g. the content of secondary structures, e.g. a relative clause, does not necessarily fall under the scope of the main speech act indicator:

- (i) Is it the case that John, who you dislike, left?
- (ii) It is not the case that John, who you dislike, left.

This is consistent with the DS assumption that the information provided by such clauses is not necessarily presented by the speaker as having the same status as the information in the main clause. Here the content of the relative is taken as background, i.e., context-constructing material (see below).

2. Juxtaposition and Subordination

One form of context-dependency in DS is modelled as relying on the set of logical forms/trees constructed by the processing of linguistic and non-linguistic input (see Cann et al. 2005 Ch. 9). This set minimally includes the trees derived by processing the immediately previous and current discourse. This ordered set is defined by Cann et al. (2005) as follows:

- (1) the sequence of trees $\langle T_1, \dots, T_n, T \rangle$ where each of T_i for $1 \leq i \leq n$ is an arbitrary complete tree and T is some partial tree under construction

We are going to call this set of trees the *Discourse Context* in order to distinguish it from two other concepts of context defined by DS. This sequence of the recently processed logical forms models the background on which anaphoric resolution and reasoning processes rely. In that respect, if a speaker needs to provide information that is not already included in this set then linguistic (or other) input can be presented to the hearer to explicitly introduce the relevant information. Following such an introduction to the Discourse Context, the presentation of subsequent input can exploit the context that has been so created by including underspecified expressions which rely on the accessibility of the just introduced information for their resolution. As regards the structuring of discourse, this feeding process can appear in the form of a sequence of clauses/minimal predicate-argument structures with anaphoric connections between them:

- (2) The Chinese are industrious. They outcompete Europe now.
 (3) The Chinese outcompete the Japanese. They are industrious

There is no necessity for the grammar to provide encoded means for processing and integrating such sequences as explicitly correlated to each other. According to the general cognitive and communicative principles postulated by pragmatic theories, the mere fact that the clauses in such a sequence are being presented as juxtaposed by the speaker will lead a hearer to recover some intended inferential connection between them (cf. Asher & Lascarides 2003). However, beyond mere juxtaposition, all languages seem to make available encoded means of presenting

complementary information in a form that makes explicit their intended parallel processing. In that respect the fact that two clauses must be processed as a single inferential unit is specifically encoded by formal means. The sentences below present the same information as (2)-(3) above with the difference that instead of employing radically underspecified anaphoric means, e.g. the pronoun *they*, in order to relate the information in the two clauses, here, separate predications are presented as unambiguously linked with an argument in the main clause. This is achieved by employing an *attributive adjective* in (4) and a *relative clause* in (5)-(8):

- (4) The industrious Chinese outcompete Europe now.
- (5) The Chinese, who outcompete Europe now, are industrious.
- (6) The Chinese, who are industrious, outcompete Europe now.
- (7) The Chinese, who are industrious, outcompete the Japanese.
- (8) The Chinese outcompete the Japanese, who are industrious.

As we have seen, according to DS assumptions, a pronoun introduces a metavariable in the semantic representation and a search of the context must be initiated in order to find a replacement for it. For instance, the metavariable introduced by the pronoun *they* in (3) above can either be substituted by the term representing the content of the phrase *the Chinese* or the term representing *the Japanese* (assuming that there are no other salient entities in the context). In that respect, according to Relevance Theory and DS assumptions, the processing of the string in (3) is only appropriate in a context where the speaker believes that it is relatively unequivocal whether he/she is referring either to the Chinese or to the Japanese as *industrious*; otherwise the speaker producing such an utterance will not be conforming to the general principles that govern communication since the hearer will be unable to achieve the intended interpretation. On the other hand, the unambiguous linking of the separate predications in (4)-(8) above with a particular argument in the main clause can be seen as a more versatile structure. This is because such structures can be used in any context, regardless of the relative salience of the attribution of “industriousness” to either the Chinese or the Japanese. Since these structures leave no

alternatives for the hearer but the obligatory attribution of a property to a designated term in the ensuing semantic representation, their use in discourse has a twofold facilitating role: (a) they provide an unambiguous structure which reduces the effort required to process the utterance contrasting in that respect with mere juxtaposition and (b) they construct explicitly the appropriate minimal context in which the main assertion is intended to be processed (for example, in (6) the claim that the Chinese outcompete Europe now is intended to be relevant for the hearer in the context of the fact that the Chinese are industrious); the latter property is shared to a certain degree with juxtaposed clauses. Viewed from the DS time-linear perspective taken here, as we saw earlier, the Discourse Context can take care of the cases that involve simple sequences of clauses in that such sequences do not necessarily involve intentional or rule-governed correlation of information (for instance, the Discourse Context will contain information that only incidentally happens to be present in the discourse environment and has not been specifically introduced by the discourse participants). However, in view of the structures in (5)-(8), it is also essential that there is a grammar-internal mechanism, beyond the general context structuring processes, that allows for a rule-governed update of the parsing environment that a speaker might want to introduce. This is because (a) there seem to be precise linguistic means of signalling these inferential connections between separate predications, e.g. relative pronouns like *who*, and, (b) from a dynamic perspective, the processing of each predication seems to be interleaved with the processing of the other.

In deciding to model such a mechanism the question that now arises for the formalism is whether it can be assumed that there is a unified concept of “grammaticised” context update that underlies the different apparent forms that such context introduction assumes inside the grammar of a single language and cross-linguistically (e.g. modification by adjectives or relative clauses, restrictive relatives, appositive relatives, correlatives etc.). Or whether there are several distinct modes of syntactic/semantic combination

as argued in “constructional” frameworks (see e.g. Fillmore & Kay 1996, Ginzburg & Sag 2000). We are going to see that DS takes the first approach in that a single processing device allows for the update of information that all such structures provide. It consists in allowing the building of separate propositional trees in parallel: the processing of a single propositional structure can be interrupted by means of the input provided by specialised linguistic devices and a new structure can be initiated; copying of information from one structure to the other will also be possible. This grammatical mechanism which allows the parallel processing of distinct predication provides a formal underpinning for the notion of a single *inferential unit*, a set of propositions that is intended to be relevant to the hearer as whole (cf. Carston 2002: 242-250). Such a unit is modelled in DS as the *global tree*, a tree encompassing (potentially infinite) minimal predicate-argument tree structures (minimal predicate-argument structure representations constitute a domain termed the *local tree* in DS). The global tree is going to be utilised later in this thesis in providing an explication of the notion of scope domains, semantic subordination and phenomena that in other standard frameworks are analysed in terms of bound variable anaphora. From a theoretical point of view, it can be seen here that, in extending the notion of context dependent processing into the grammar formalism, the DS framework seems to integrate both aspects of more traditional grammatical frameworks like Minimalism (see e.g. Chomsky 1999) and discourse based approaches like various versions of DRT (Kamp & Reyle 1993, Asher 1993). It is a crucial assumption of the framework that such a separation of remit is not necessary (at least for the phenomena that involve structural and monotonic processes) since many of the phenomena that pertain to this distinction can be treated in a unified way. We are going to see now how and why this point of view offers a solution to many issues traditionally arising at the syntax/semantics interface as well as in the processing of discourse.

3. LINK structures

Beyond the mere sequential juxtaposition of clauses in a discourse the concept of a “grammaticised” linking between separate predications seems to be an option available in the grammars of all languages. But the specific formal means that achieves the encoding of such linking varies. In some languages there is a general subordinating marker used to loosely encode some type of correlation between two clauses. In the examples below from Warlpiri the two clauses in each sentence could be taken as sequentially juxtaposed but for the fact that the subordinating conjunction *kutja* appears in one of them:

(9) *Warlpiri*, from Hale (1976:78)

yankiri-li	<i>kutja-lpa</i>	ɲapa	ɲa-ɲu,	ɲatjulu-lu-ɲa	pantu-ɲu
emu-ERG	SUBORD-PAST	water	drink-PAST,	I-ERG-AUX	spear-PAST

The emu which was drinking water/While the emu was drinking water, I speared it.

(10) *Warlpiri*, (ibid)

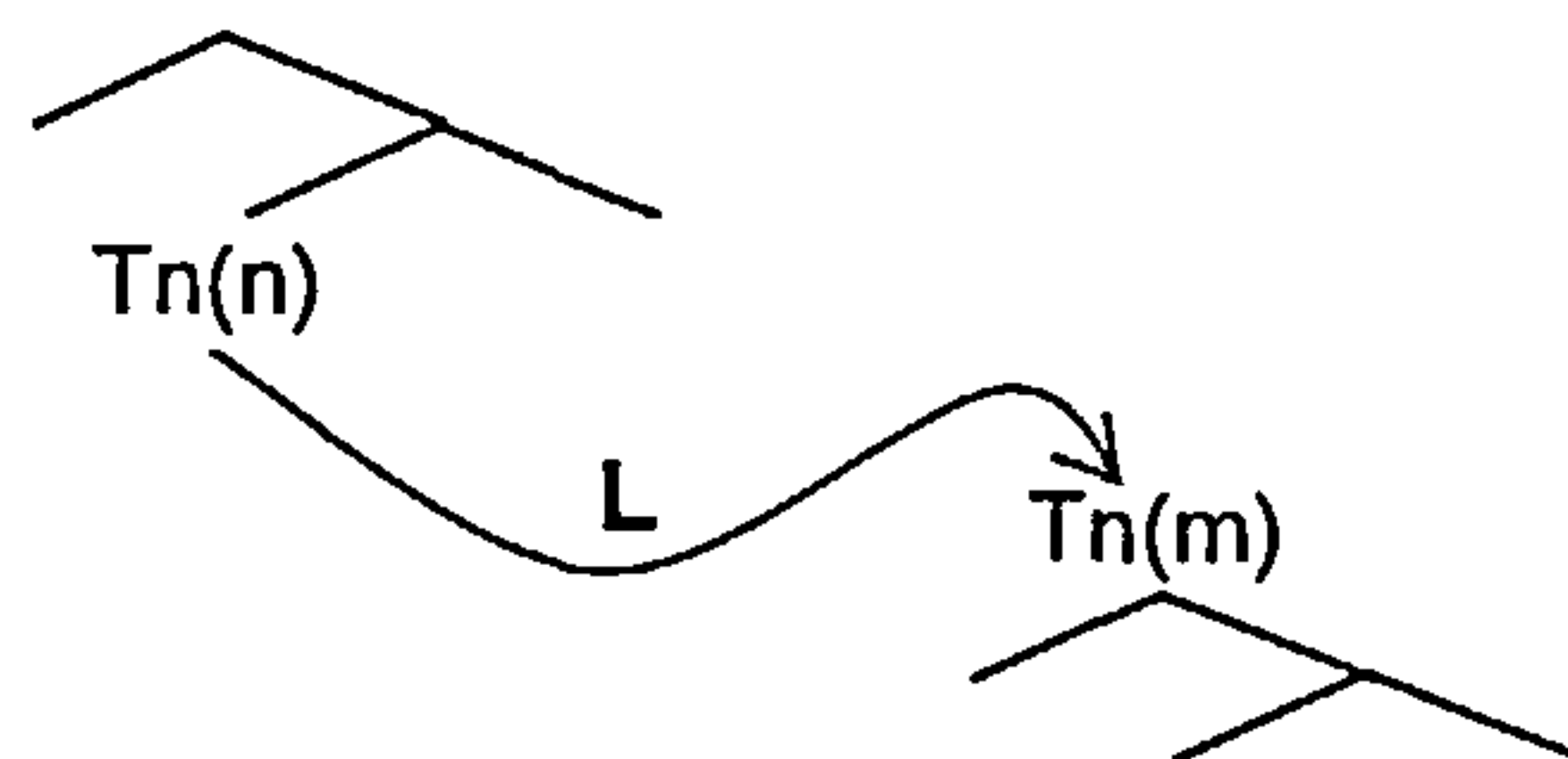
ɲatjulu-lu-ɲa	yankiri	pantu-ɲu,	<i>kutja-lpa</i>	ɲapa	ɲa-ɲu
I-ERG-AUX	emu	spear-PAST,	SUBORD-PAST	water	drink-PAST

I speared the emu which / while it was drinking water.

These might be interpreted as the equivalent of a relative clause and a main clause in English, in which case there is an obligatory overt anaphoric connection between the arguments of the two verbs; on the other hand, the clause including the conjunction *kutja* can be interpreted as an adverbial modifier of the other clause. The underspecification of interpretation for such structures, which relies on context and other linguistic means like tense for disambiguation, shows that although at minimum there is a necessary correlation of the information in the two clauses (see Keenan 1985), there is no need for positing distinct syntactic underlying structures as a means of achieving this correlation in each particular instance. Instead, the context-dependent underspecification of this type of correlation can be captured by a general device, available to all languages, which allows the processing of two separate predicate-argument structures in parallel. In DS this general device is modelled by employing the concept of a new relation between two separate trees called *LINK*. The LINK relation between two tree-nodes will be shown diagrammatically by means of an arrow connecting the node where the LINK

relation originates and another tree which becomes correlated to it. We will call the node from where the LINK relation originates the *LINK mother* ($Tn(n)$ below) whereas the node where the LINK relation terminates will be called the *LINK daughter* ($Tn(m)$ below).

(11)



To allow the construction and processing of such correlated trees the language-particular DS toolbox includes specific actions that introduce the LINK relation and move the pointer and information from one linked node to another. The onus for introducing such relations can be assumed by general Computational Rules or be born by specialised lexical items or even be shared among those grammatical devices. The subordinator *kutja* in Warlpiri above could be taken to impose a requirement that the two trees to be constructed out of the two clauses are connected by means of the LINK relation. This requirement will only be satisfied if a general Computational Rule exists which can establish this relation between nodes of the two trees. The anaphoric/rhetorical connections perceived as necessarily holding between the two clauses can be taken as a result of the common requirement accompanying LINK constructions that there is sharing of information between the two trees. Since the establishment of the LINK relation does not seem to unambiguously indicate which piece of information should be copied, such structures can be analysed as involving either copying of a term from the individual domain (relative) or from the temporal/modal domain (adverbial clause) (see e.g. Bittner 2001 for an analysis in these terms).

Although the LINK connection between two logical forms may have no unambiguously expressed shared term as in Warlpiri above, in other languages two clauses can be juxtaposed through the use of specialised anaphoric devices which explicitly indicate which piece of information should

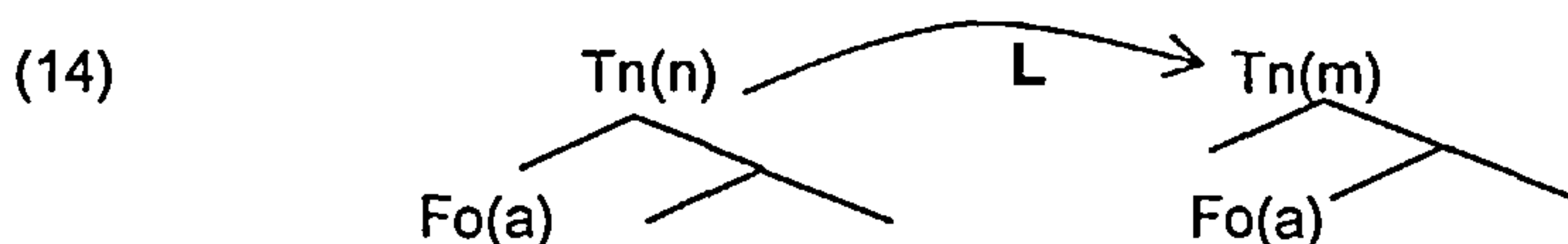
be copied from one tree to the other. For example, relatives and correlatives in Hindi are introduced with specialised pronouns (*jo* below) whereas a demonstrative pronoun (*vo*) in the main clause is obligatorily construed as correferential with it:

(12) [Jo larkii kari hai] vo lambii hai
 [who girl standing is] that tall is
 The girl who is standing is tall

(13) Vo larkii lambii hai [jo kharii hai]
 that girl tall is [who standing is]
 The girl who is standing is tall

Hindi, from Srivastav (1991)

In these cases the relative pronoun *jo* can be taken to impose the restriction that there must be a LINK relation between the current tree and another one, similarly to the Warlpiri conjunction *kutja*. But, being a pronoun, *jo* also contributes a term in the tree constructed out of the correlative. The fact that there must be an anaphoric connection between the two clauses can be encoded in the grammar if we analyse pronouns like *jo* as indicating that there must be a copy of the term they contribute in each of the two trees. This shared term is then obligatorily provided by assigning the requisite interpretation to the demonstrative *vo* in the second clause:



The Warlpiri and Hindi constructions seen above involve two sequentially juxtaposed clauses (*correlatives*) with specialised lexical items indicating their connection. It can also be seen that such correlatives show variable linear orders like *if*-clauses and other adverbial clauses in English. Moreover, adverbial clauses in many languages employ similar formal devices as nominal correlative clauses, a fact which strengthens the claim that, cross-linguistically, there is a single means of integration instead of various unrelated constructions:

- (15) [dzo manus itha sikawto] to madzha bhau ahe Marathi (Pandharipande 1997,
 who man here teach that mine brother is cited in Bhatt & Pancheva 2001)
 the man who teaches here is my brother
- (16) [dzithe sawə li hoti] , lithe Ram bəsla Marathi (Andrews 1985)
 where shade was there Ram sat-down
 'Where there was shade Ram sat down.'
- (17) [dzər to ithə yel], tər mi tya-la goli marin.
 if he here comes then I him bullet kill-will
 If he comes here, then I'll kill him.'

Across languages there are also constructions where the two clauses show more structural integration than simple linear juxtaposition. For example, the Hindi correlatives seen above in (12)-(13) have clause-internal counterparts:

- (18) Vo larkii [jo kharii hai] lambii hai Hindi, from Srivastav (1991)
 that girl [who standing is] tall is
 The girl who is standing is tall

This construction is the parallel of English relatives where the processing of the relative can be interleaved with the processing of the main clause:

- (19) The Chinese, who are industrious, outcompete Europe now.

Viewed from a time-linear perspective it seems that there are clear processing reasons that explain why relative clauses that are adjacent to the head noun and interrupt the processing of the main clause should evolve in natural languages. First of all there is the minimisation of ambiguity that results from the elimination of free context search mentioned above in relation to (4)-(8). Secondly, the existence of two strategies for presenting the same truth-conditional content, either by interrupting the processing of the main clause or by using two separate clauses, can be exploited by the speaker for additional inferential and truth-conditional effects. For example, the effect of restrictive and non-restrictive interpretations can be equally achieved by juxtaposition as well as the use of a relative; however, presentation by use of a relative structures the information it as the background for the processing of

the information in the main assertion (this is why sometimes it is claimed that relatives present *presupposed* information⁴⁷):

Restrictive interpretations:

(20) Some Europeans are industrious. Those will survive the competition.

(21) The Europeans that are industrious will survive the competition.

Non-restrictive:

(22) The Chinese outcompete the Japanese. They are industrious.

(23) The Chinese outcompete the Japanese. The Chinese are industrious.

(24) The Chinese, who are industrious, outcompete the Japanese

In this respect it is notable that English also maintains the correlative strategy seen above in Hindi in the so-called *extraposed relative* construction (see Kempson 2003):

(25) A friend visited John yesterday who I haven't seen for years.

In these structures the ambiguity as to the attachment of the relative's content is maintained and there are inferential effects associated with the choice of such a positioning of the relative (as well as restrictions as to the context that will be selected for its processing). Moreover, adverbial clauses in English, although they can be integrated, appear often in the correlative construction (see Geis 1985, Bhatt & Pancheva 2001 and Chapter 6):

(26) If John comes then Mary will leave

(27) When John comes then Mary will leave

The case of embedded relatives is also interesting in terms of the function of anaphora in that the relative is processed in the context created by the processing of (part of) the main clause while, at the same time, the

⁴⁷ This is not a justified claim because relatives can certainly introduce new information in the discourse e.g.

(i) A: What did Mary do?

B: Mary cursed John, who then left

Informational downgrading of the content presented by the relative seems to be a more accurate description of what is often achieved by the use of a relative as opposed to a main clause. See also Kadmon (2001: 13), Kempson (2003), Arnold (2005).

relative itself provides the immediate context for the processing of the rest of the main clause. This can be seen in the potential for anaphoric relations. A term introduced inside the main clause can provide a copy for the substitution of a metavariable contributed by a pronominal inside the relative; therefore, in that respect, the main clause contributes the context in which the relative is processed (besides the grammaticised correlation of the head with the relative pronoun):

(28) A woman_i [who I saw leaving her_i house] has been taken to hospital

On the other hand, the relative can introduce terms to be used as replacements for the metavariables contributed by pronominals in the main clause:

(29) The man [who a friend of mine_i likes] told her_i to shut up.

And in fact both types of anaphoric connection can exist at the same time:

(30) A woman_i who a friend of mine_k saw kicking her_i car decided to sue him_k.

From a discourse point of view it is therefore essential that such structures are constructed in parallel following the time-linear introduction of information so that at each stage in the parse there is a record of what terms become available.

In the next section we will provide the precise mechanism for the processing of nominal relative clauses in English. The point of the previous discussion though is that the rules employed for the processing of such structures in English must be seen as specialised variants of general rules available in all languages and underlying many natural language constructions.

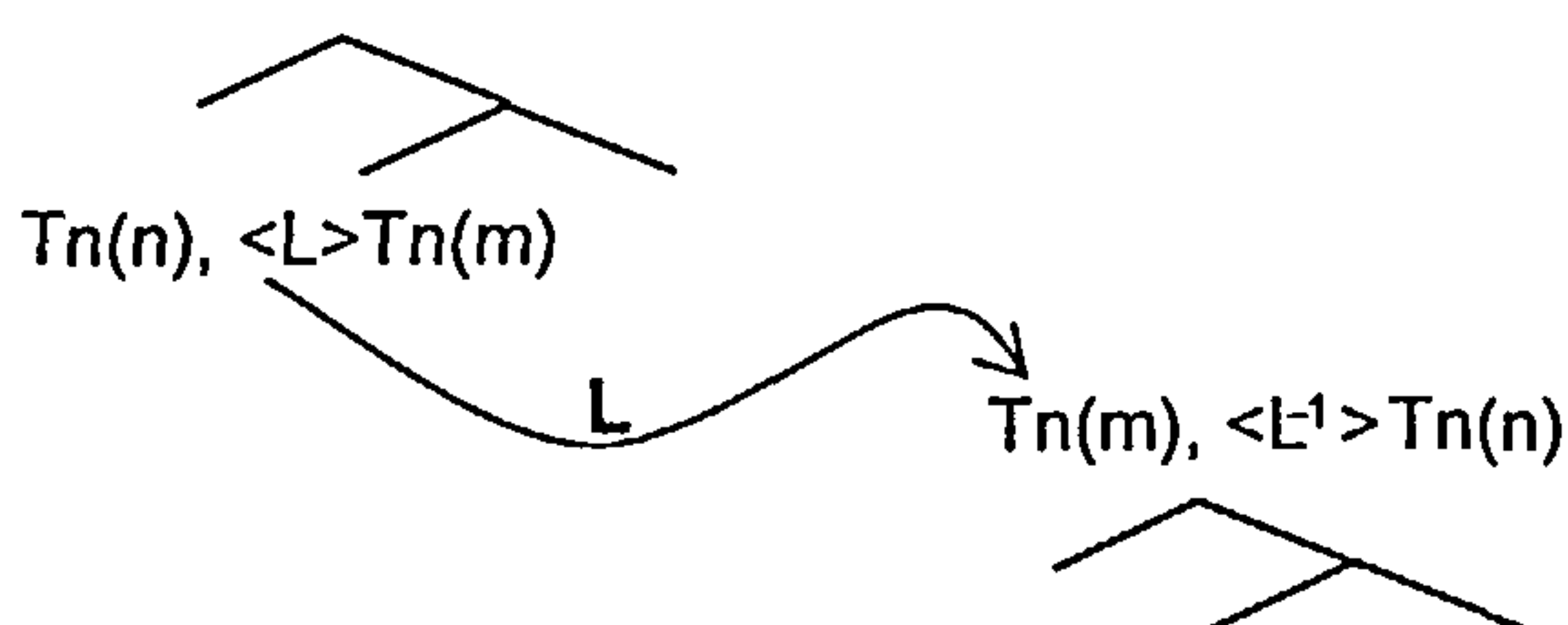
3.a. Processing of Relative Clauses in DS

Relative clauses in English occur adjacent to the nominal to which they are related (except in cases of extraposition). The noun to which the relative is attached is called in the traditional and syntactic literature the *head* of the relative (*John* below):

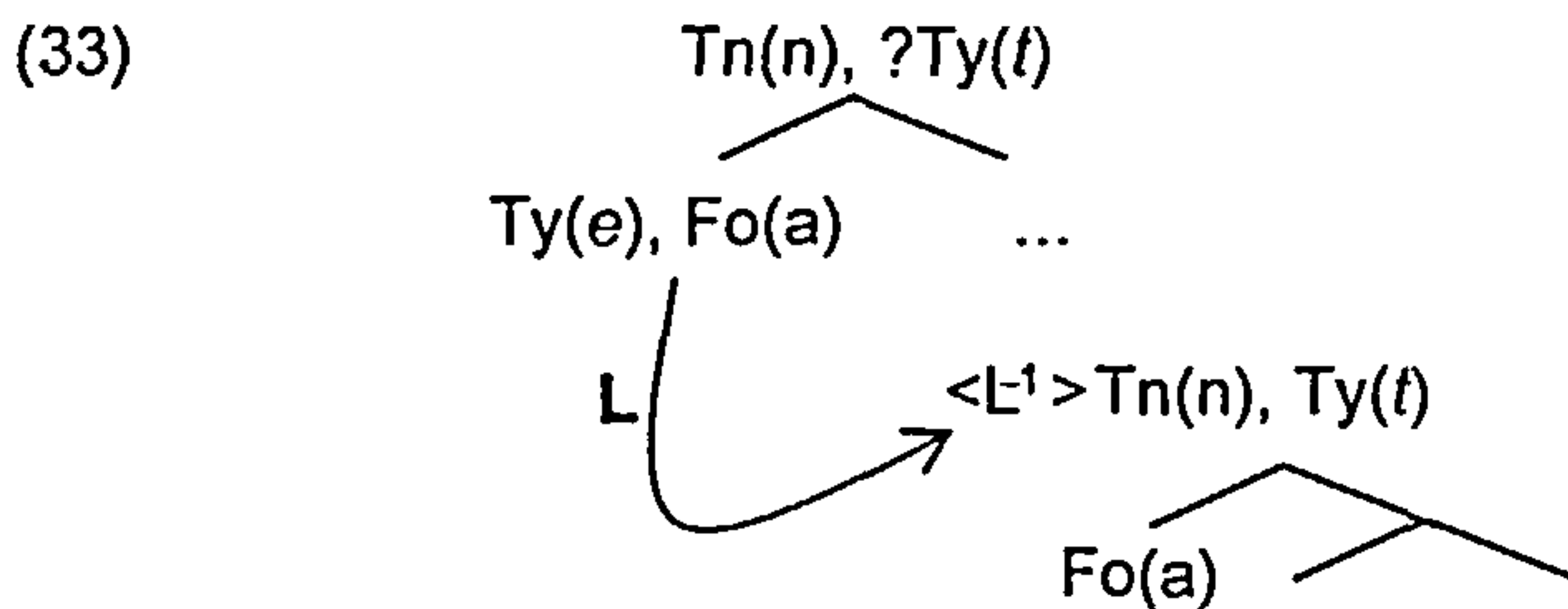
(31) John, who I like, left

Characteristically, the relative clause and the head noun must share some semantic content. Since the element inside the relative that is construed as providing the shared content has an independent syntactic role there, truth-conditionally, there are two separate propositions constructed by the parsing of such constructions. In the DS semantic representation this is modelled by the construction of two trees none of whose nodes are related by a dominance relation. Instead, a distinct type of tree-relation, the LINK relation, is defined between two nodes of the two independent trees. In terms of the tree description language LOFT a new operator $\langle L \rangle$ is introduced to express this relation. From the LINK mother's perspective below, the position of the LINK daughter can be described as $\langle L \rangle Tn(m)$, which can be read as "it is possible to take one step across the LINK relation and find $Tn(m)$ ". From the perspective of the LINK daughter $Tn(m)$ we can talk about the LINK mother by employing the inverse LINK modality $\langle L^{-1} \rangle$: $\langle L^{-1} \rangle Tn(n)$ below means "it is possible to take one step backwards across the LINK relation and reach $Tn(n)$ " :

(32)



In the particular case of nominal relatives in English the LINK connection is established between a type e node and a type t one:



In terms of the dynamics of such structures, the fact that the construction of a representation for the content of the main clause is interrupted by the need to process the relative requires the means for initiating a new propositional structure during the processing of another. Therefore a transition rule has to be defined that initiates the new proposition and moves the pointer there. Moreover, the need for a shared formula value between the two trees has to be catered for. We will present the rules and representations appropriate for the parsing of such structures through the presentation of the parsing of two sentences, one containing a restrictive and the other a non-restrictive relative. We start with Non-Restrictives as the simpler case.

3.a.1. *Parsing of non-restrictive relatives*

We will go through the parsing steps leading to an interpretation for the following sentence containing a non-restrictive relative:

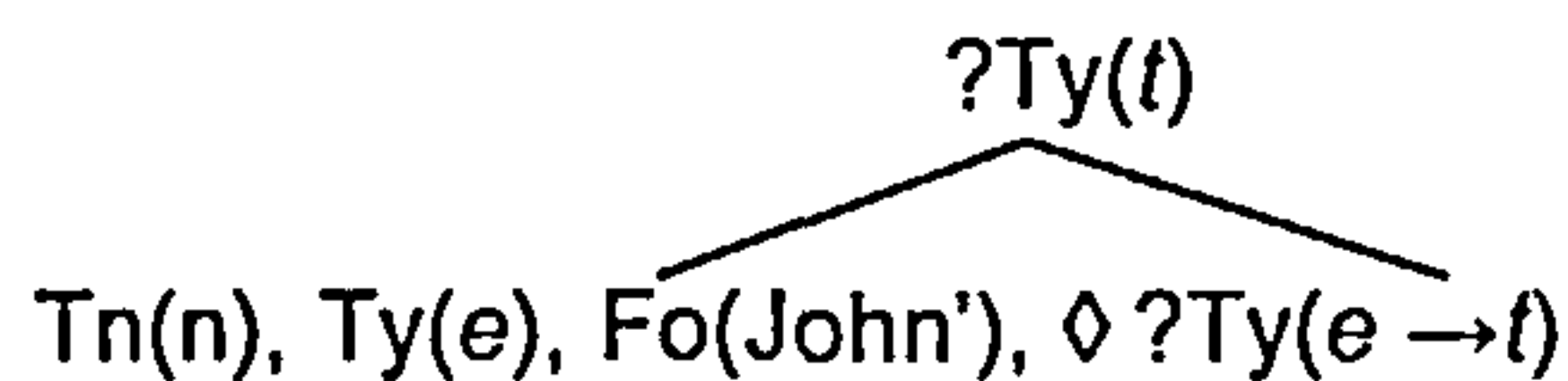
(34) John, who cried, left

We start with the *Axiom*, the minimal tree consisting of just a root node with a requirement for the derivation of a Formula value of type t .

(35) $Tn(a), ?Ty(t), \diamond$

As usual the rules of Introduction and Prediction will construct the subject and predicate nodes and parsing of the lexical item *John* will lead to the following representation (we will give the address of the subject node as simply $Tn(n)$ since, for the purposes of the illustration here, it does not matter what the exact specification of the node address is; we omit the other addresses for simplicity):

(36)

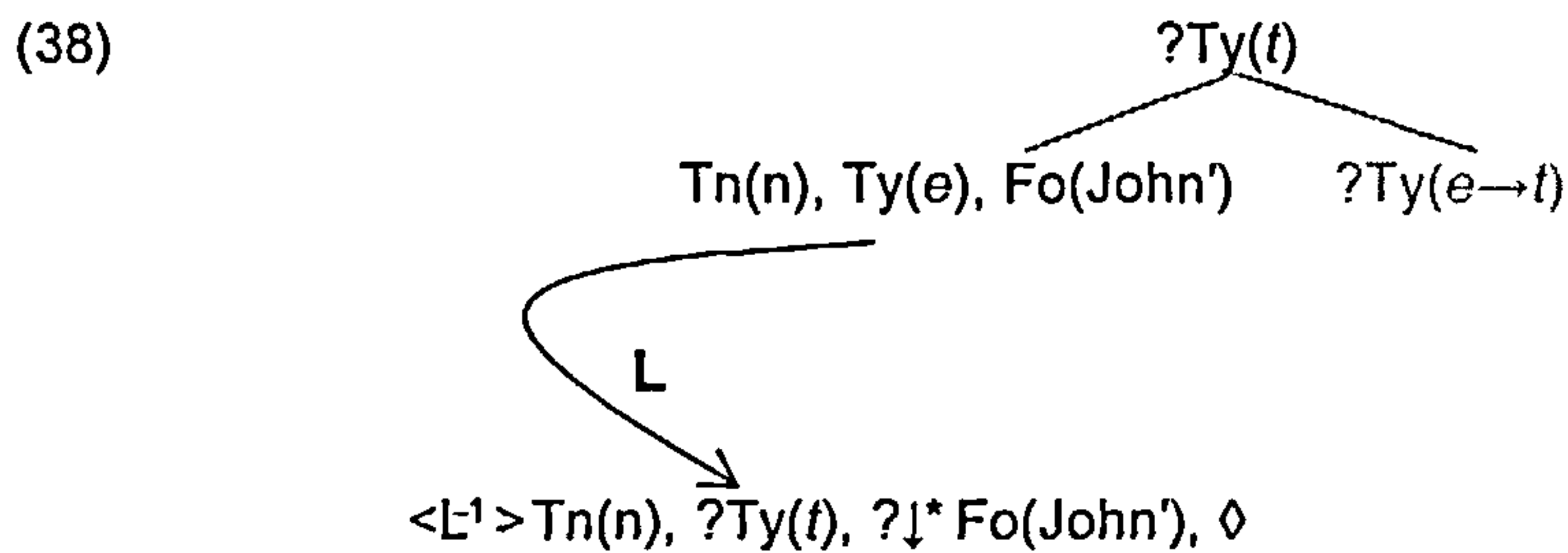


At this point in the parsing there is the option of invoking a new rule called the rule of *Link Adjunction* which will allow the processing of the relative clause that is to follow:

(37) **Link Adjunction**

$$\frac{\{...\{ Tn(X), Fo(a), Ty(e) \dots \diamond \} \dots \}}{\{...\{Tn(X), Fo(a), Ty(e) \}, \{ <L^1> Tn(X), ?Ty(t), ?\downarrow^* Fo(a), \diamond \} \dots \}}$$

This rule applies if the pointer is at a node that matches the node description given above the line: because of the schematic letters X and a employed in the rule, any address ($Tn(X)$) and any completed formula value ($Fo(a)$) can be matched as long as the node is of type e . The effect that application of this rule has is given below the line: a new tree is initiated by building a root node bearing a requirement for a type t formula; a LINK connection is constructed between the “head” type e node (the *LINK mother*) and the $?Ty(t)$ node (the *LINK daughter*); the pointer is moved to the newly constructed $?Ty(t)$ node; a requirement is placed on this node that it has to dominate a node which bears a copy of the formula value decorating the *LINK mother* ($?\downarrow^* Fo(a)$). This is how the tree above would look like after the *Link Adjunction* rule has applied (the schematic $Tn(X)$ in the LINK Adjunction Rule has matched the value $Tn(n)$ in the tree and $Fo(a)$ has matched the value $Fo(John')$):

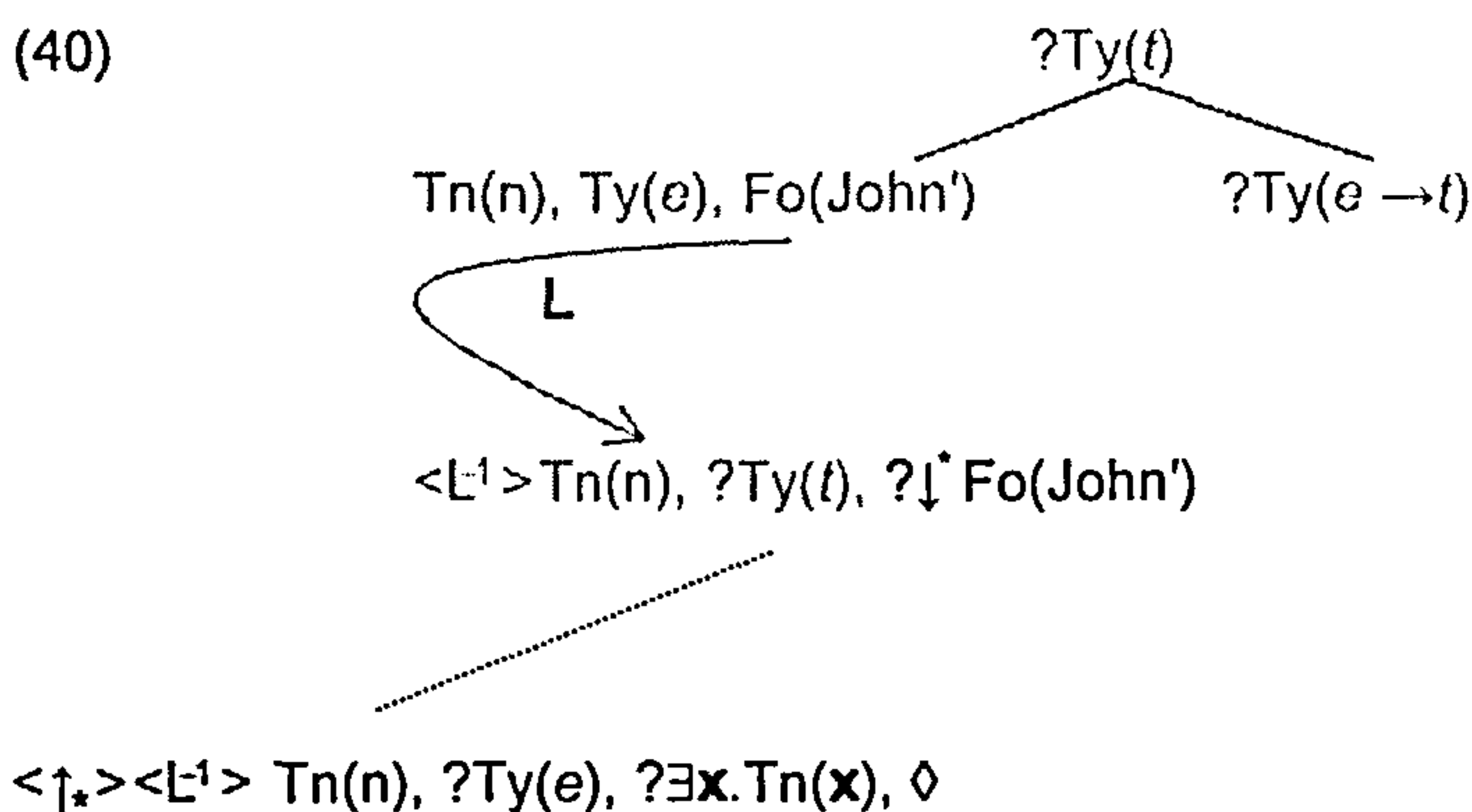


The newly initiated propositional tree is an ordinary tree in every respect except the requirement for dominating a copy of the formula decorating the *LINK mother*. As all the usual rules of processing apply to this tree, the description at the *LINK daughter* node matches the input specification for the rule of *Adjunction (see Ch.2, repeated below); therefore the actions specified in this rule can apply to the tree in (38):

(39) * **Adjunction Rule**

$$\frac{\{ \dots \{ \{ Tn(a), \dots ?Ty(t), \emptyset \} \dots \} \}}{\{ \dots \{ \{ Tn(a), \dots ?Ty(t) \}, \{ \langle \uparrow_* \rangle Tn(a), \dots, ?\exists x.Tn(x), ?Ty(e), \emptyset \} \}, \dots \}}$$

Applying this rule will have the effect of introducing an unfixed node bearing requirements for its type to be of $Ty(e)$ and for a fixed position on the tree ($? \exists x.Tn(x)$):



Now with the pointer at the unfixed node the relative pronoun *who* must be processed. Relative pronouns in English are taken in DS as specialised lexical items whose main function is to place a copy of the formula occupying

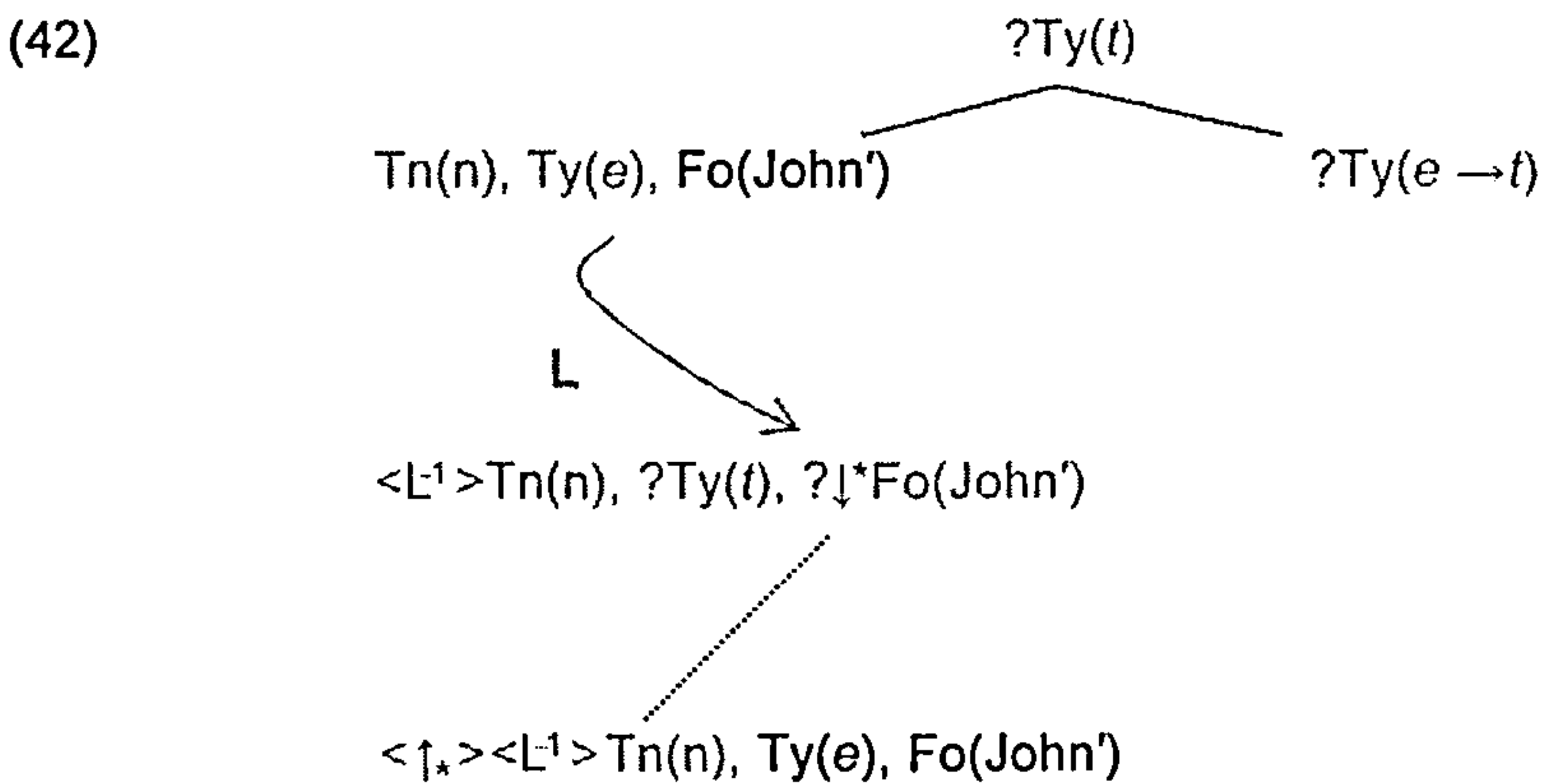
the *LINK mother* node at an unfixed node where the pointer currently resides. Combined with the *LINK Adjunction* rule this satisfies the need for a term shared between the relative and the main structure. The lexical entry associated with processing the relative pronoun *who* in English is as follows:

(41) ***who_{rel}***
IF $?Ty(e), ?\exists x.Fo(x), <\uparrow_*><L^1>Fo(x)$

THEN $put(Fo(x), Ty(e), [\downarrow] \perp)$

ELSE abort

The rule in (41) first checks if the pointer is at an unfixed node ($?\exists x.Fo(x)$) with a requirement $?Ty(e)$. Moreover that unfixed node must be located beneath a *LINK daughter* node. The *LINK mother's* Formula value can now be captured by use of the bold variable x inside the Fo value. Whatever Formula value is found at the *LINK mother* node instantiates x in the rule and will now be copied at the node where the pointer is ($put(Fo(x))$). Additional decorations indicating that this is a node of type e and a terminal node ($[\downarrow]\perp$) are also placed there. Here is the tree constructed after the processing of the relative pronoun *who*:



The fact that the copy of the formula at the *LINK mother* node is introduced at an unfixed node inside the LINKed tree makes it possible to process structures where the shared term can be as deeply embedded in the relative as required. In our current example in (34) the shared term plays the role of the subject in the relative but it is equally possible for the term to be at any

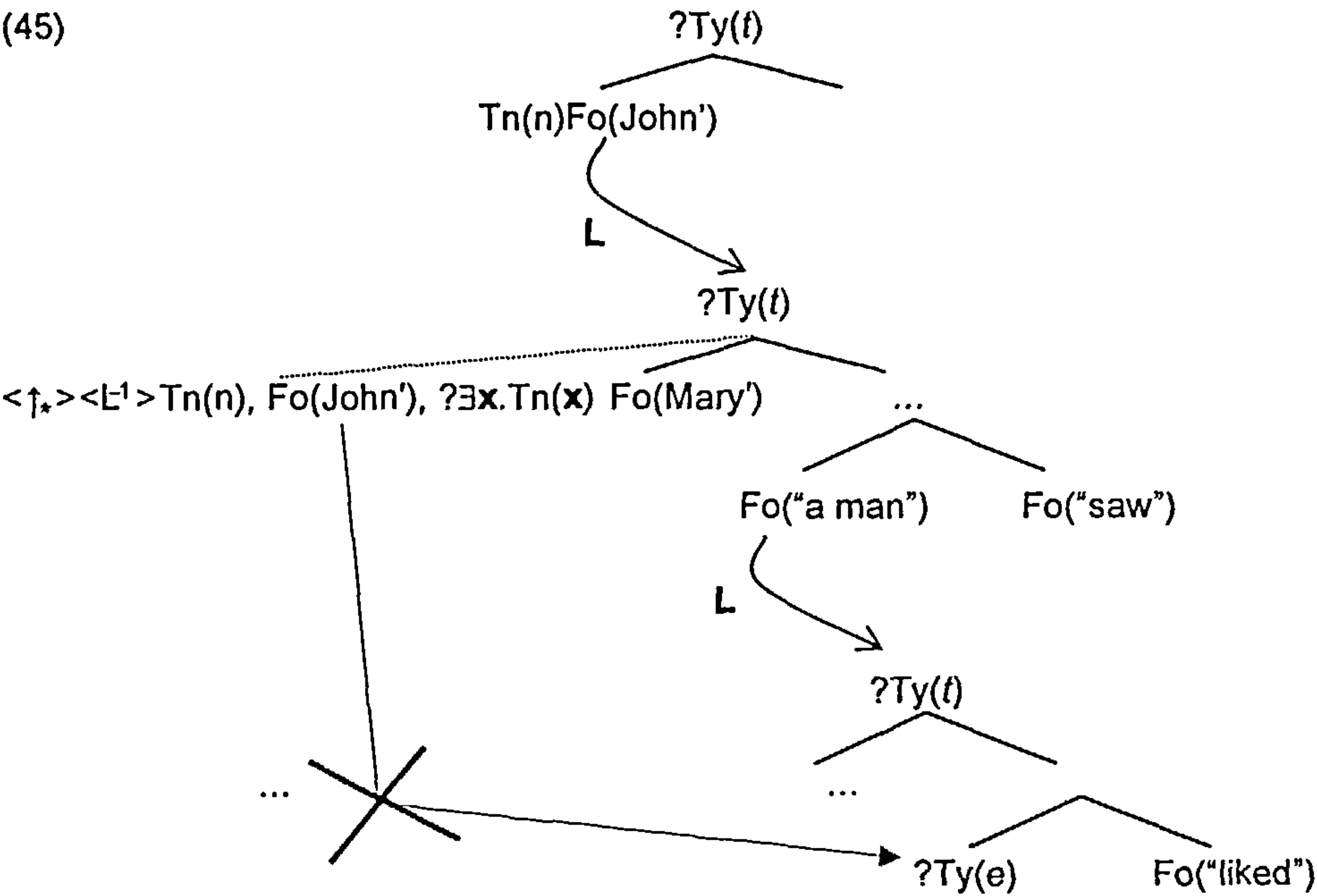
embedded position as long as this position can be characterised as *dominated* by the *LINK daughter*:

(43) John, [who Mary said that Bill dislikes __ a lot] left yesterday.

What is excluded, exactly because of the nature of unfixed nodes, is the shared term appearing inside another relative clause:

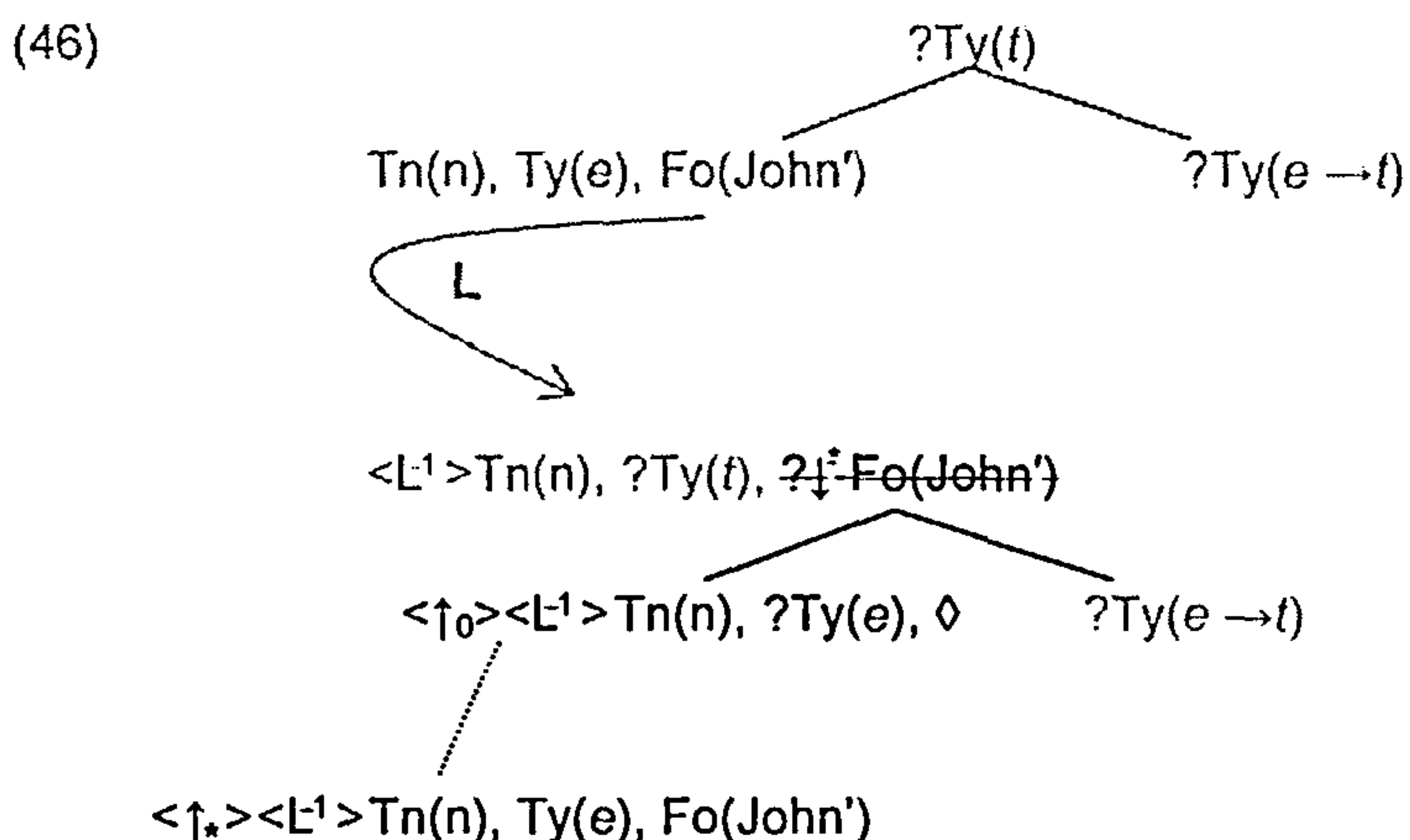
(44) *John, [who Mary saw a man [who liked __]], left.

This is because processing of the second relative will ensue in a new LINKed tree. But the requirement for the unfixed node to merge at a position *dominated* by the first *LINK daughter* ($\langle \uparrow_* \rangle \langle L^1 \rangle Tn(n)$) does not allow for merging inside another LINKed tree. By definition there are no dominance relations between the nodes of two LINKed trees (in that respect a *LINK mother* is not a *mother* and a *LINK daughter* is not a *daughter* in the dominance sense). The schematic tree below shows what is disallowed in that particular case:



It can be seen from the above that the requirement for the unfixed node bearing the copied term *John'* to merge at some dominated position will never be satisfied in (44) and the structure will be declared ungrammatical.⁴⁸ This is how the *strong island* property of relatives and other similar structures is captured in DS.

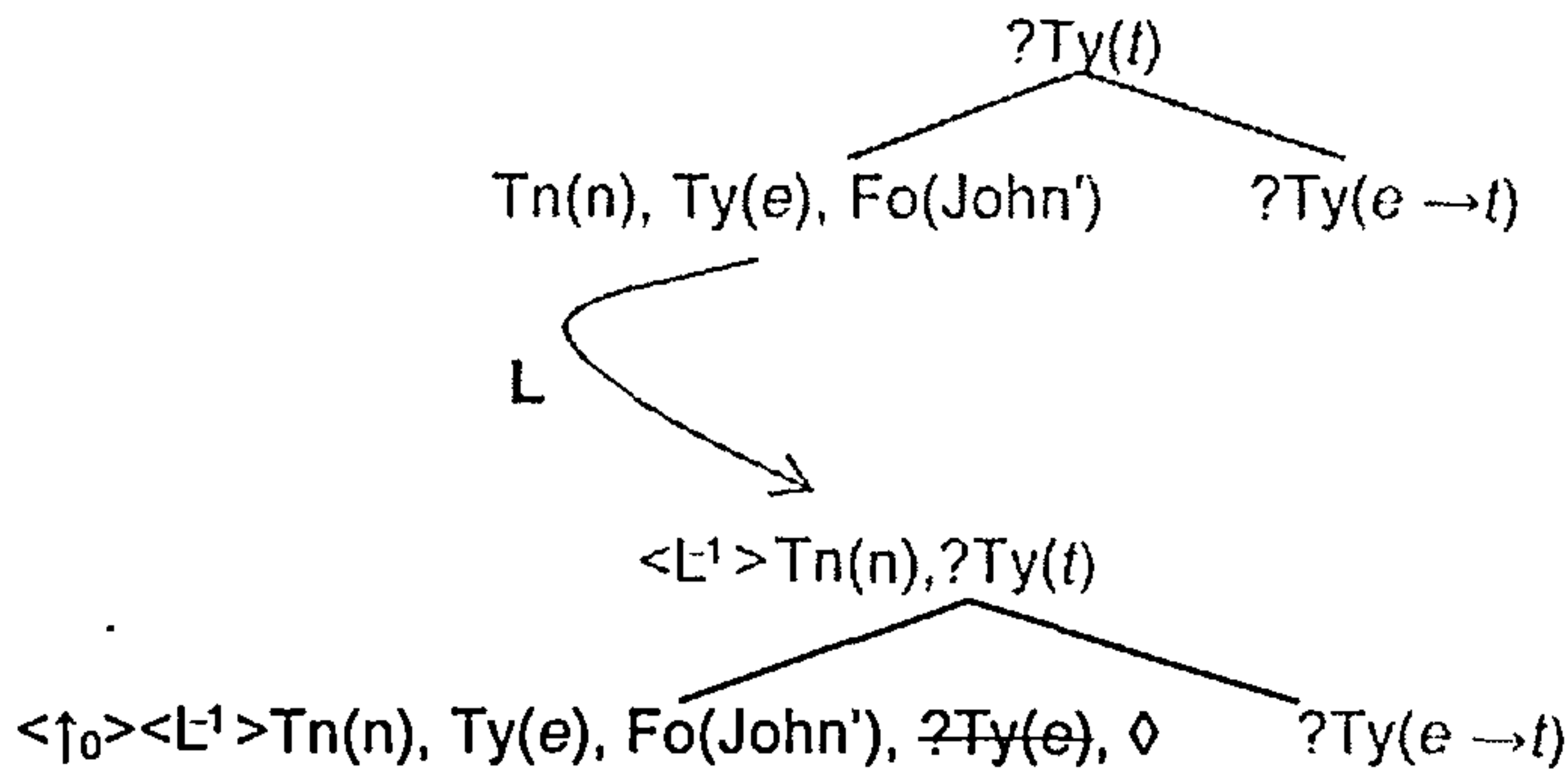
Going back to our example in (42), with the type and formula requirements on the unfixed node now satisfied the rule of *Completion* (see Ch.2: (44)) can move the pointer at the ?Ty(t) node. The presence of the decoration *Fo(John)* at the unfixed node now satisfies the requirement $? \downarrow^* Fo(John)$. Parsing of the linked tree can now proceed in the usual way. Introduction and Prediction (see Ch.2: (39)-(40)) will build the subject and predicate nodes and the unfixed node will come to hang below the subject node (the *Normal Form Constraint*, see Ch.2: 5.a.9):



At this point the unfixed node can merge with the subject node providing an appropriate address for itself and a Formula and Type value for the subject node:

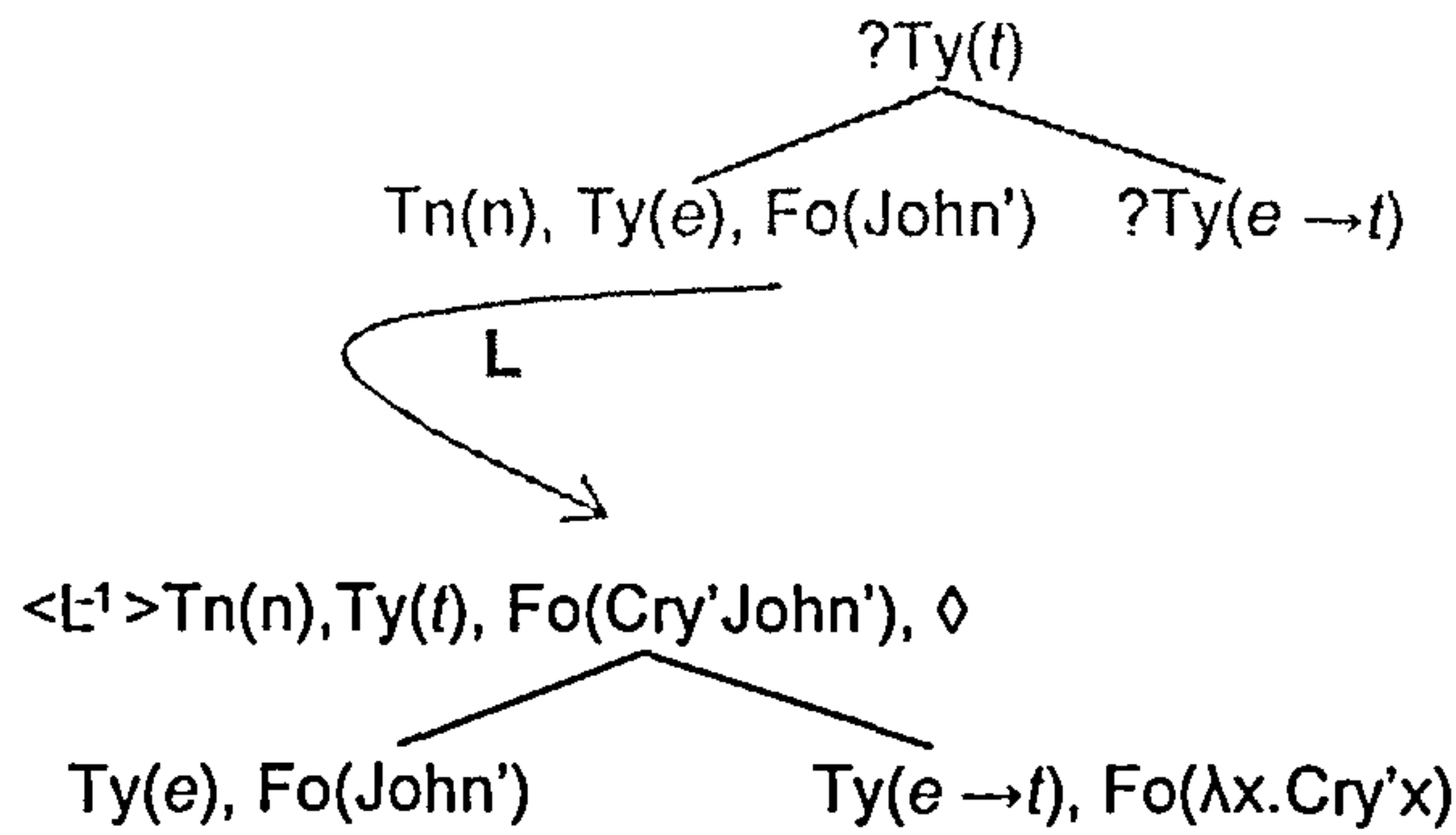
⁴⁸ In addition to <L>, the modality <D> and its inverse <U> are interpreted across both dominance and LINK relations. Those modalities would allow merging inside LINK structures.

(47)



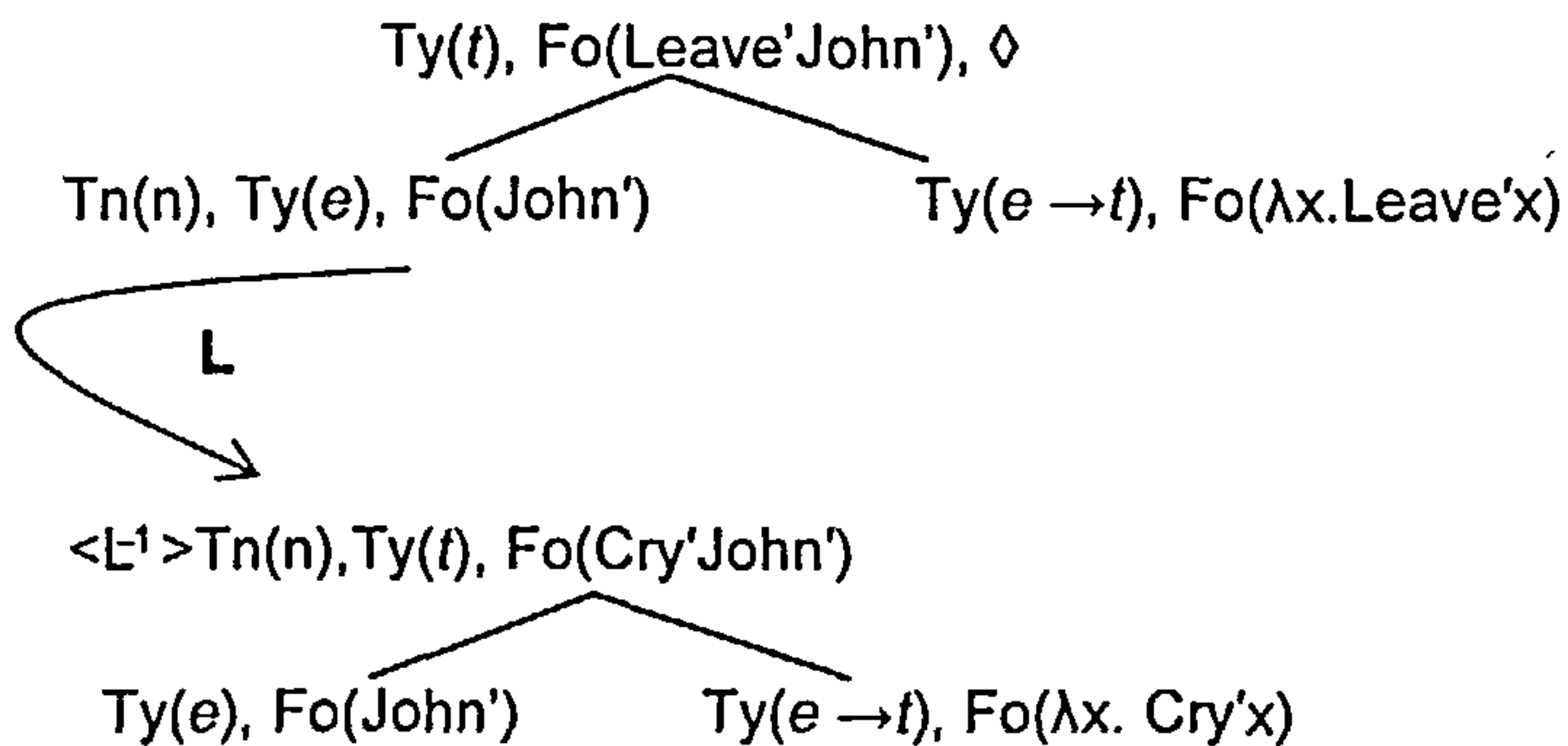
Parsing of the verb *cries* will now decorate the predicate node and the tree can be completed as usual deriving a formula value of type t at its root, the *LINK daughter* node:

(48)



By means of the rule of Completion the pointer now moves from the *LINK daughter* to the *LINK mother*. After parsing of the verb *left* and completion of the main tree the semantic representation for the string in (34) will look as follows:

(49)



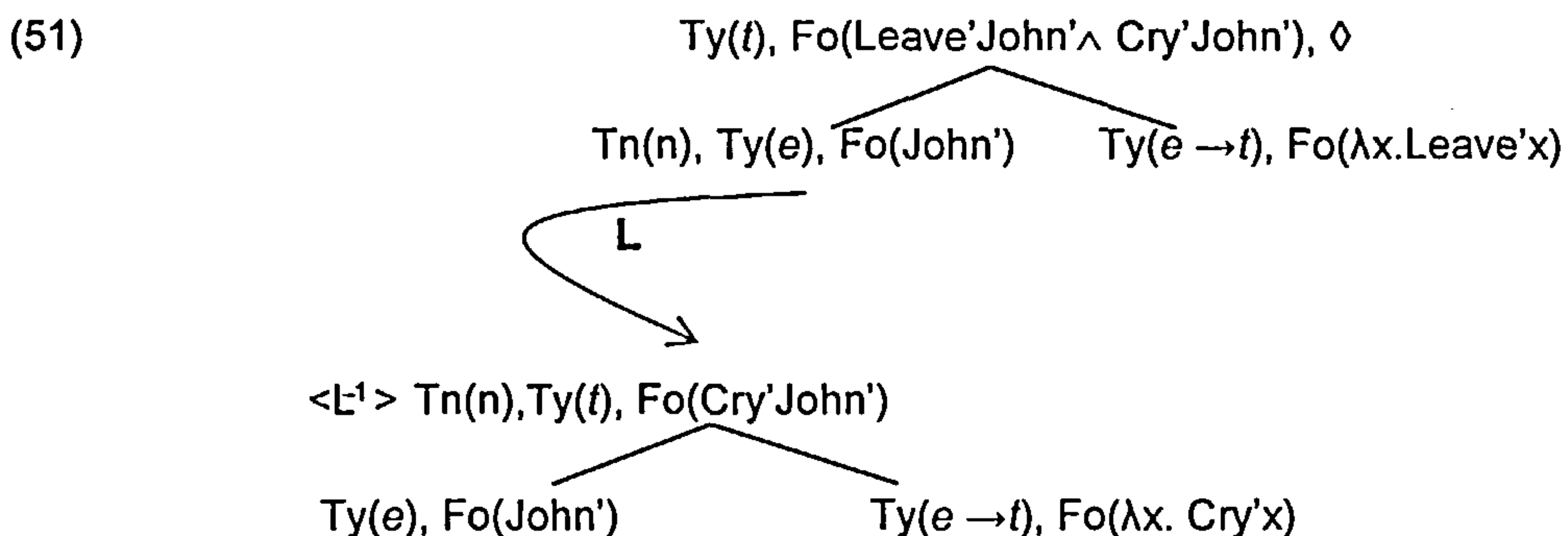
The fact that the two propositions were presented as a single unit by the speaker can now be taken into account by integrating the content of the relative into the content of the main clause (this is the sense in which the relative is *subordinated* to the main clause, the content of the main clause incorporates the content of the relative not the other way round). The following rule takes two propositional trees connected by means of the LINK relation and transfers the content of one to the root node of the other. The combined content of the two trees appears as a conjunction of the two propositions:

(50) **Link Evaluation 1 (non-restrictives)**⁴⁹

$$\frac{\{...\{Tn(n), Fo(a), Ty(t) \dots \Diamond\} \dots \{<L^1>MODTn(a), Fo(b), Ty(t)\}...\}}{\{...\{Tn(n), Fo(a \wedge b), Ty(t) \dots \Diamond\} \dots \{<L^1>MODTn(a), Fo(b), Ty(t)\} \dots\}}$$

$MOD \in \{<\uparrow_0>, <\uparrow_1>\}^*$

The result of the application of this rule to the tree in (49) above is the following:



This is the (simplified) completed structure derived from the parsing of a non-restrictive relative⁵⁰. Before we present the derivation that gives rise to a

⁴⁹ In view of comments in the literature regarding truth judgments of speakers when asked to evaluate sentences containing false non-restrictive relatives it has been proposed that at least some cases involve two distinct propositions rather than one conjoined proposition (see e.g. Bach 1999, Neale 1999, Carston 2002: 131 and fn. 26). The fact that all rules are optional in DS can be utilised here to account for these intuitions. The specific Link Evaluation Rule above can be taken as applying optionally without ungrammaticality ensuing especially since DS now provides a formalisation of the context (see Cann et al. 2005, ch. 9) which will ensure that the two propositions inhabiting the two LINKed trees will be maintained (however for this to be implemented a means for pointer return to the main tree has to be defined independently, i.e. without copying of information).

semantic representation for a restrictive relative we have to explain what the distinction between Restrictives and Non-Restrictives relatives is taken to be in DS. This is the purpose of the next section.

3.a.2. *The distinction between restrictive and non-restrictive relatives*

In the syntactic literature a distinction is commonly made between *Restrictive* and *Non-Restrictive/Appositive* relatives. Distinct attachment sites are assumed for each type of relative clause and sometimes distinct grammatical levels are taken to be relevant for their combination with the main clause (Safir 1988). In terms of truth-conditions, according to Quine (1967), the content of a restrictive relative is a predicate, not a full proposition. On the other hand, the content derived from a non-restrictive is generally assumed to be propositional. As a result, Restrictives are usually interpreted as objects of type $\langle e, t \rangle$ (Partee 1975) whereas Appositives yield propositions of type t (Sells 1985, Demirdache 1991, Del Gobbo 2002).

3.a.2.a. *Interaction with quantification*

The assumption that restrictive relatives yield predicative content has led to the claim that they can only modify nominals of type $\langle e, t \rangle$, thus providing additional restrictors for quantificational expressions. Besides the distinct syntactic mechanisms that are used to analyse restrictive relatives, Heim and Kratzer (1998) and Del Gobbo (2002) a.o. invoke distinct rules of interpretation to deal with restrictive modification. The rule of *Predicate Abstraction* creates a predicate out of a proposition by, in effect, abstracting over a variable (the *trace*) included in the representation of the relative's content. A new semantic composition rule called *Predicate Modification* combines the content of the relative with that of the noun. In this type of analysis pronouns inside a relative construed as coreferential with the head

⁵⁰ For simplicity of the illustration we have assumed that proper names project simple terms of type e . However, in fact, proper names, as well as all other NPs, are assumed in DS to give rise to terms with complex structure (see Cann et al. 2005). Definite noun phrases also project a complex structure including a metavariable to be identified from context and a restrictor which incorporates the content of the common noun (see Kempson et al. 2001).

are also interpreted as variables bound by the quantificational determiner which combines with the common noun head:

(52) *Every man* [who admitted *he* was late] was given time to prepare

On the other hand, the assumption in much of the literature has been that Appositives are independent sentences interpreted as propositions of type *t*. For this reason they can only combine with referential phrases whose semantic content is of type *e* (Ross 1967, Rodman 1976, McCawley 1988). In Heim & Kratzer's (1998) system the Predicate Modification method of composition is not available for the content of such clauses as they are not interpreted as predicates. As a result, it is claimed that Appositives cannot modify quantificational phrases. However, these claims do not seem to be in agreement with the data. The following are a sample of actually attested examples (see Appendix 1 for more examples and sources) in which a non-restrictive relative combines with a quantificational phrase (even if a restrictive interpretation might be available is some of the examples, it is not necessarily the only one):

- (53) Voter turnout will be maximized by hands-on GOTV efforts. GOTV should be more than signing up voters leading up to the election, it should be about energizing voters NOW. What better way to maximize this than to have a consistent message passed to *every county chair, who then passes it on to every District chair, who then passes it on to every block captain, who then discusses it with their friends and neighbors at the park, the pool, the coffee shop, the diner.*
- (54) The colonizers, in their efforts to create scarcity in order to dominate the nation - they came and forcibly channelled the country's wealth i.e. land and natural resources to *few white settlers who then had power over the majority of the indigenous people.*

More recently, under her analysis of relative pronouns in Appositives as *E-type* pronouns, Del Gobbo (2002) has claimed that Appositives can be combined with certain types of quantifier as long as the relative appears sentence-finally (and in special "telescoping" or subordination contexts, see Sells 1984). This also do not seem to be the case as these attested examples show (see Appendix 1 for full list):

- (55) In some state and local jurisdictions, Route 6 mileage markers are found every mile, and in many places the current 6 is given such names as "6 Hwy" (Ohio) or "Hwy 6 Trail" (Iowa). *Most old segments, which have been bypassed either by a newer Route 6 or by placement of 6 on an interstate highway,* are not marked in the western states.

- (56) How about talking to Academy members about this? These folks are bright, visionary and creative. It appears that *most Academy members, who certainly care about intellectual property rights, profits they helped create, and their job future* are shocked, appalled and very troubled by the hasty MPAA actions and they would prefer a suspension of this action and an opportunity to help find and execute the better solutions.
- (57) The audience for the debate largely sided with Suzuki. Not surprisingly, *most Americans (who of course never read "Philosophy East and West")* tended to prefer Suzuki's timeless truths to Hu Shih's medieval past, his idealized Zen Japan to Hu Shih's remembered Chinese tradition.
- (58) Often the construction is carried by *few wealthy individuals who then* recoup their expenses by collecting funds from farmers of the newly irrigated land who then own and operate the system.
- (59) Holbek could not of course make use of such performance data, as he was working with texts collected in nineteenth century Denmark, a period when *most collectors (who of course lacked modern recording methods)* habitually omitted or excised materials not felt to be part of the text proper. Mrs Kerfont's comment validates a sexual reading of this and other symbols.

As can be seen from the data and contrary to claims in the literature non-restrictives modifying quantifiers neither necessarily appear only sentence-finally nor require special subordination contexts or particular quantificational expressions. Moreover, analyses which postulate special "restructuring" rules of movement for the content of the appositive relative to be integrated under a Text node (see e.g. Del Gobbo 2002) fail to account for the fact that such clauses, like Restrictives, fall inside the scope of the quantifiers they co-occur with. This can be seen in the following sample of examples⁵¹ (see Appendix 1 for full list):

- (60) *Every candidate* has a message, *which he* keeps repeating to people's attention until they memorize *it*
- (61) There are in the month of Ramadhan in every day and night those to whom Allah grants freedom from the Fire, and there is for *every Muslim* a supplication *which he* can make and will be granted.
- (62) *Almost every man* had a belt, *which he* did not want to let out of his possession.
- (63) The smaller force of guerrillas had none of these, but *virtually every soldier* had a gun, *which he* used.

⁵¹ The quantificational expression *every* has been used in the examples because it has been claimed that its combination with a singular pronoun gives a clear indication as to its scope. Similar examples have been found with other quantificational expressions.

- (64) One difference I noted was that, in this war, the American soldier is a technological wonder. *Nearly every soldier owns a laptop, which he or she uses to play games or exchange e-mails from home.*

In contrast, the DS analysis in Kempson et al. (2001) and Cann et al. (2005) treats appositive relatives, as well as Restrictives, as providing content of type *t*. The manner of combination of the content of the relative with the content of the main clause is dealt uniformly with the same machinery as other coordinated, subordinated or juxtaposed clauses, i.e. as LINK structures. In conformity to such an analysis and contrary to claims in the literature, coordinated clauses and restrictive and non-restrictive relatives are expected to behave all similarly, for example, with respect to allowing extension of the scope of quantifiers (see Kempson 2003). The following attested examples show that, contrary to assumptions in the literature, quantifiers can extend their scope inside coordinated and other subordinated and juxtaposed clauses (see Appendix 1 and 4 for the full list and sources):

- (65) After all, *every murderer when he kills* runs the risk of the most dreadful of deaths, whereas those who kill *him* risk nothing except promotion.
- (66) *Every citizen, if he is a good citizen*, will bring to bear on such questions *his* best judgment and will do whatever *his* duty demands toward putting into effect such policies as are determined upon.
- (67) Liberty is given to *every individual*. *If he* wants to turn himself towards a good path and be righteous, the power is in *his* hands; *and if he* wants to turn himself towards the path of evil, the power is in *his* hands....
- (68) At the turn of the century, there was no question about it --marriage was thought to be the ideal state for *every woman*, *and she pretty much spent most of her young life preparing for it*.
- (69) *Every man, and he need not be always a professional sportsman*, longs for being the best at something sometimes.

The parallel scope-extended domain for quantificational expressions that both appositive relatives, restrictive relatives and coordinated/subordinated clauses exhibit can be captured by the time-linear sensitive mechanisms that DS provides. As we have seen these mainly consist of: (a) construction of preliminary name-like entities as the content of all noun phrases, (b) modelling of the gradual information accumulation as parsing proceeds, and, (c) a common manner of combination for the content of correlated clauses (which is the function of the LINK relation among trees). A clear sense of how

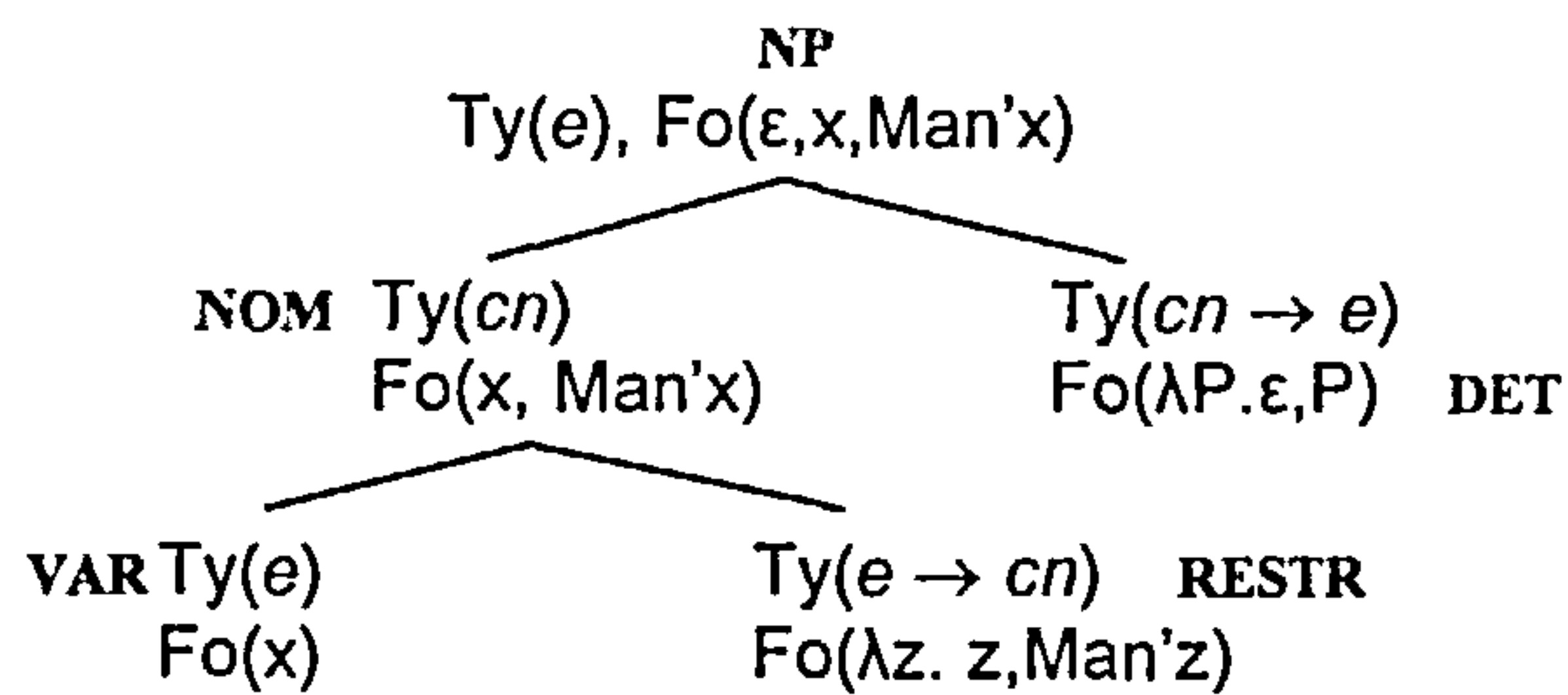
all these factors interact can be discerned in the processing of restrictive relative clauses to which we turn now.

3.a.3. Parsing of restrictive relatives

3.a.3.a. Restrictive relatives and quantification

As we said earlier, quantificational phrases in DS give rise to structures of the following shape (for illustration we use the representation derived from the NP *a man*)⁵²:

(70)



Since in this representation there are two type *e* nodes, the LINK Adjunction rule in (37) above can apply either when the pointer appears at the NP node, in which case the interpretation of the relative will be as a Non-Restrictive/Appositive, or when the pointer appears at the VAR node in which case the interpretation of a Restrictive will ensue. In order to illustrate how this is achieved in the latter case we will go through the steps of processing a restrictive relative combined with an indefinite.

3.a.3.b. The parsing steps

We will provide (a condensed version of) the steps leading to the construction of a logical form for the following sentence:

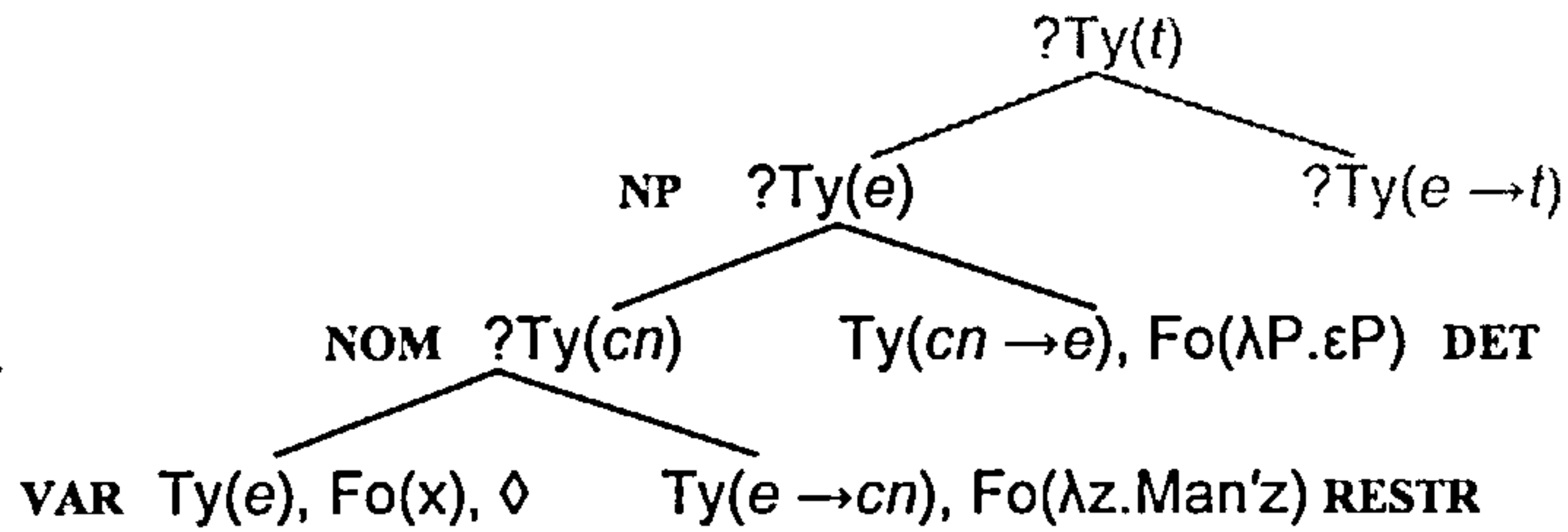
(71) A man who cried left

As usual the construction process starts with the *Axiom* and Introduction and Prediction build the subject and predicate nodes (we ignore situation arguments and several other decorations here for reasons of space). Parsing

⁵² Remember that the shaded labels on nodes are just there for the purpose of being able to refer to the nodes in the presentation and play no role in the DS framework.

of the phrase *a man* will lead to the construction of the complex structure appearing below the subject node. The lexical input provided by the common noun *man* will leave the tree as follows:

(72)



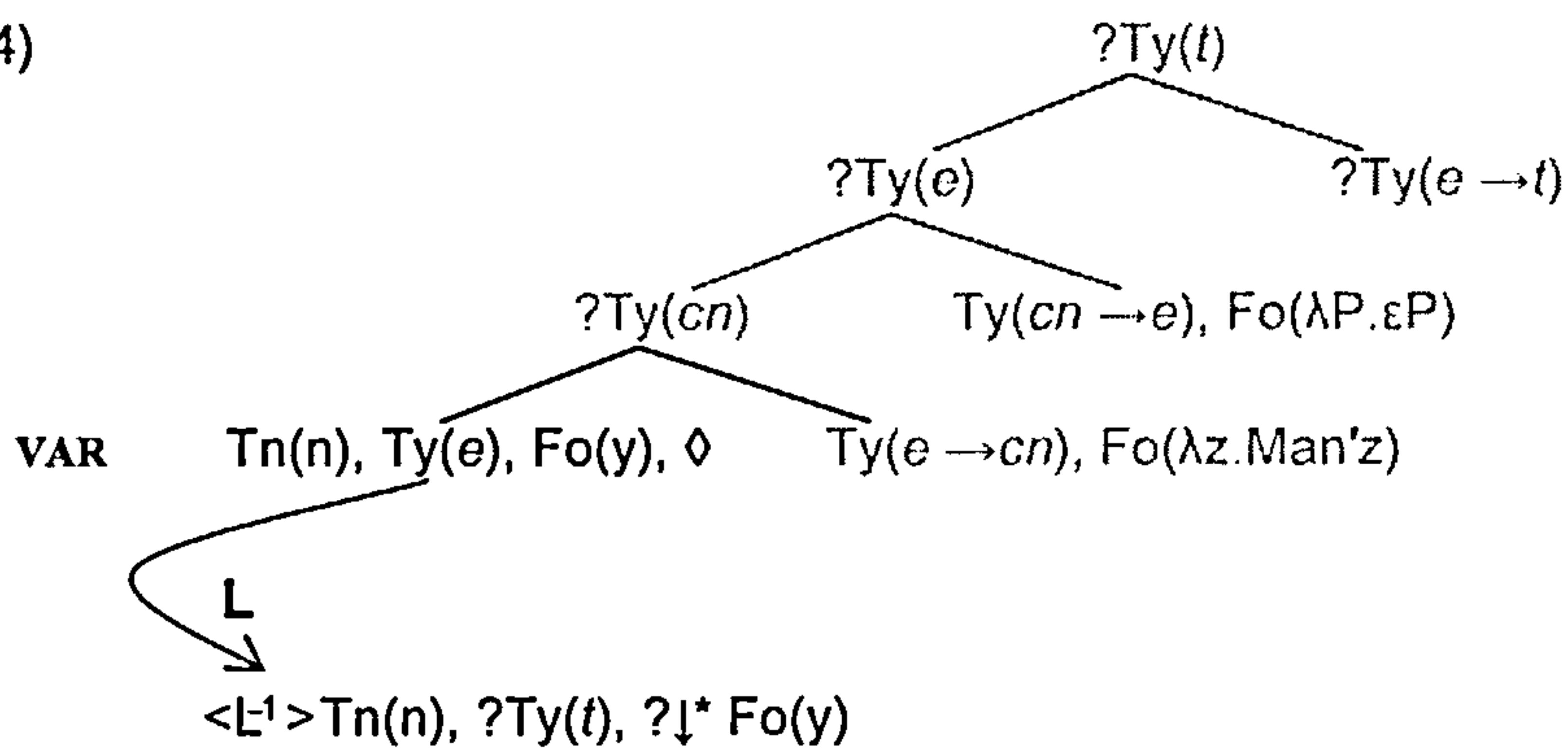
With the pointer being at the lowest type *e* node, VAR, the LINK Adjunction rule (repeated below) can now apply since the description above the line matches the description appearing in VAR:

(73) *Link Adjunction*

$$\frac{\{...\{Tn(X), Fo(a), Ty(e) \dots \Diamond\} \dots\}}{\{...\{Tn(X), Fo(a), Ty(e)\}, \{<L^{-1}>Tn(X), ?Ty(t), ?\downarrow^* Fo(a), \Diamond\} \dots\}}$$

The effect of this rule on the tree above is shown below:

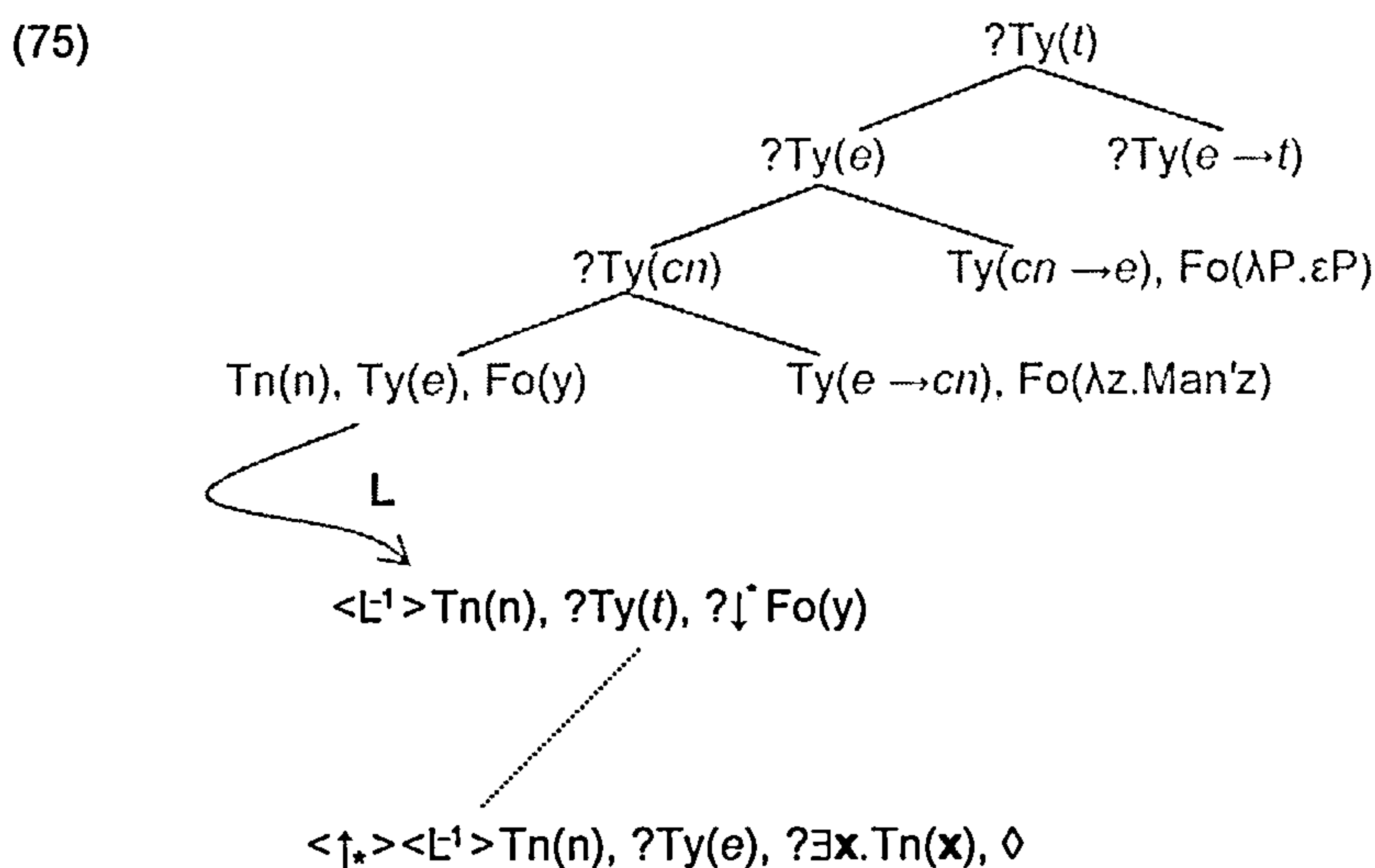
(74)



A LINK relation is established between the VAR node (the *LINK mother*) and a new *?Ty(t)* tree (the *LINK daughter*). The root node of this tree bears the requirement for a copy of the variable appearing at the VAR node to also be found in some dominated position (*?↓*Fo(y)* above). This is what eventually provides the shared element between the content of the main clause and the content of the restrictive relative. As in our case this shared term is a free variable, the linked tree will provide the type of object that in the Heim &

Kratzer (1998) framework has to be created by the case-specific rule of *Predicate Abstraction*.

Going on with the parse of the string in (71), the rule of *Adjunction can now apply since the decorations on the $?Ty(t)$ node matches what is required for its application. Application of *Adjunction will have the effect of introducing an unfixed node awaiting lexical input of type e . This input is expected to be provided by the relative pronoun:

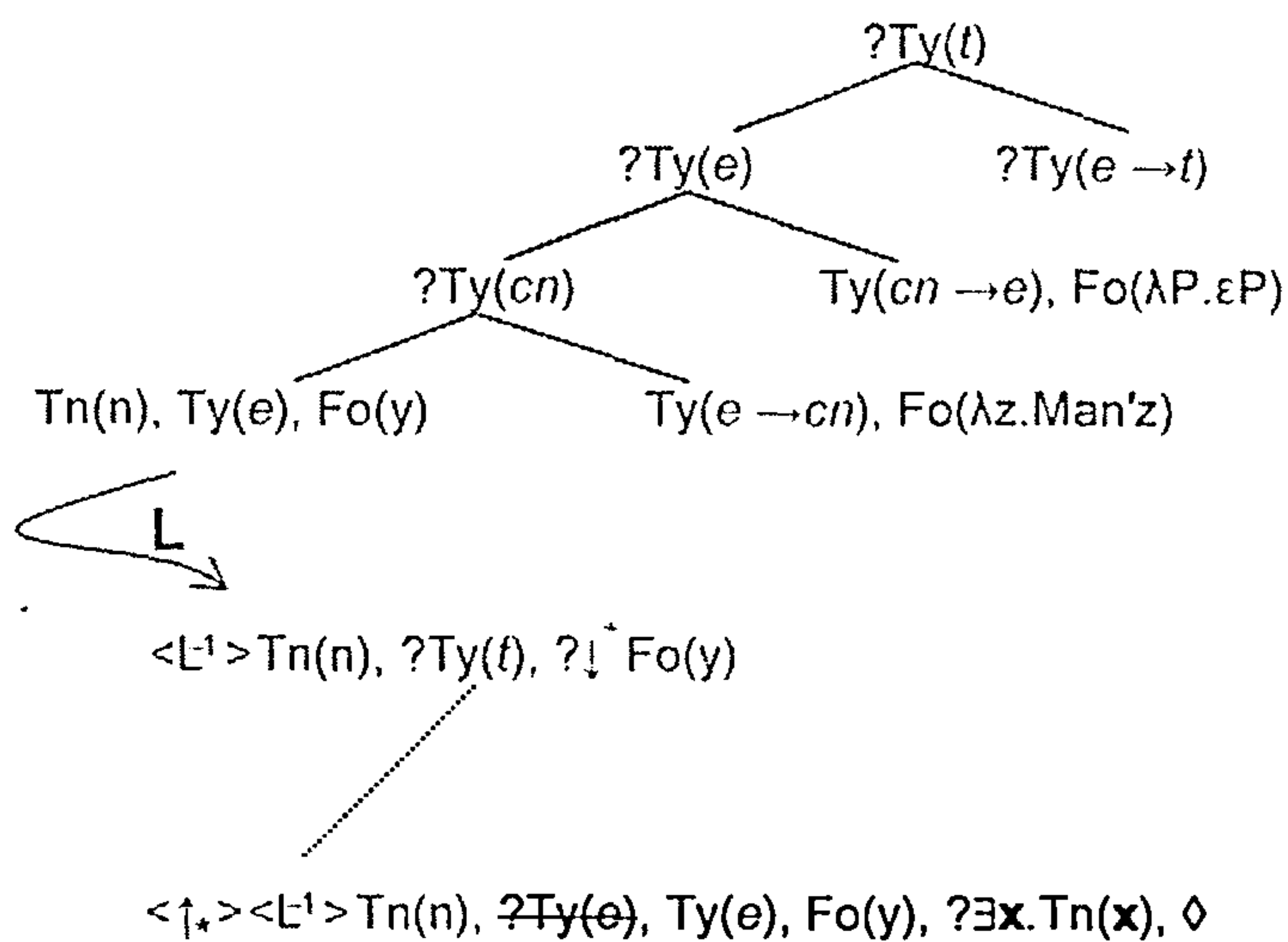


At this point everything is in place for the condition (IF ...) in the lexical entry of the relative pronoun *who* to be matched and the set of actions associated with it to be activated:

(76) **who_{rel}**
 IF $?Ty(e), ?\exists x.Fo(x), <\uparrow_s><L^1>Fo(x)$
 THEN $put(Fo(x), Ty(e), [\downarrow] \perp)$
 ELSE abort

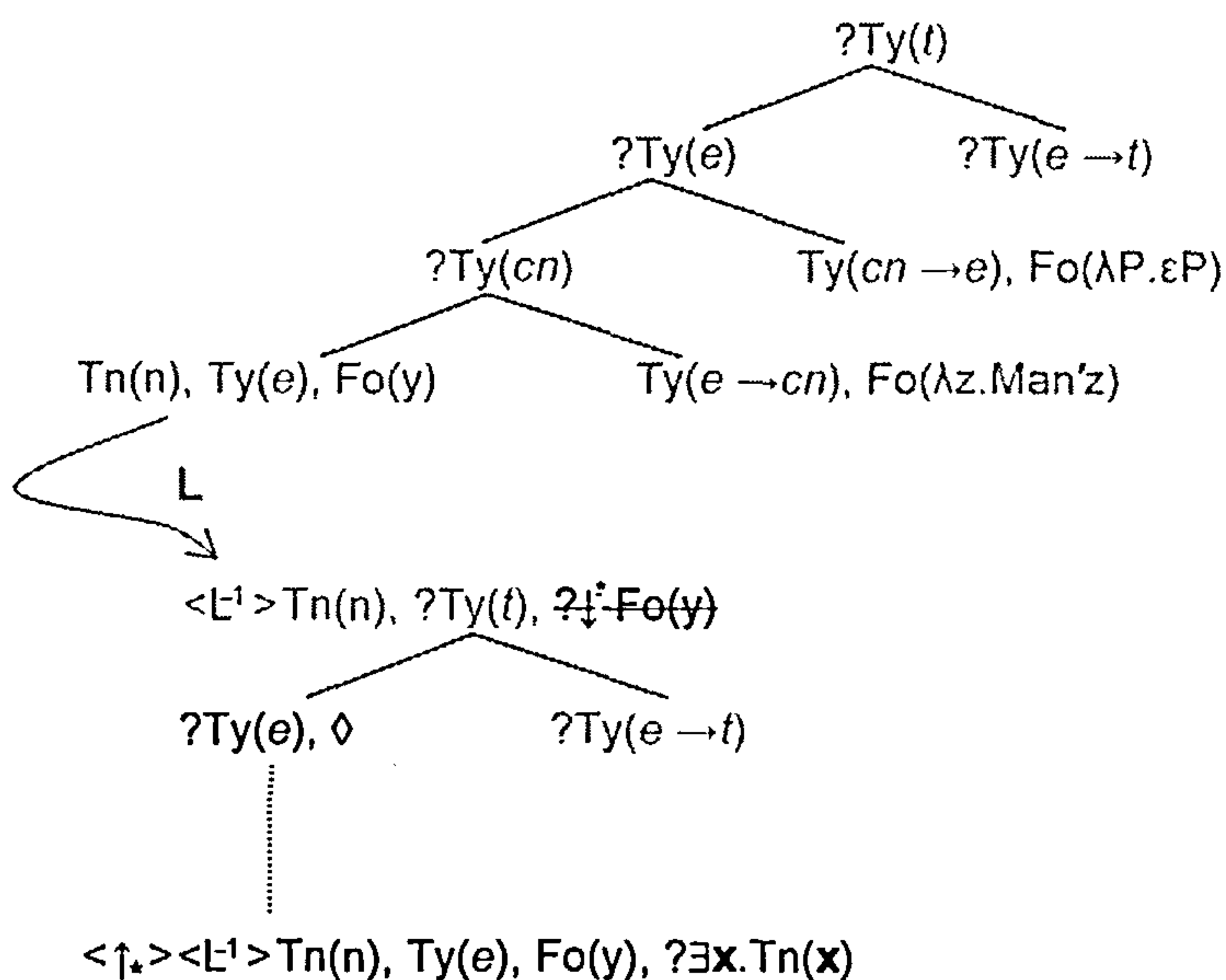
The IF condition checks whether the pointer appears at an unfixed node on a LINKed tree with a requirement for an object of type e . If this condition is fulfilled then there is a copying of the Formula value decorating the *LINK mother* node to the unfixed node where the pointer appears. This will satisfy the requirement, $?Ty(e)$, on this node and will provide the requisite copy of the head inside the relative. The tree will be transformed as follows:

(77)



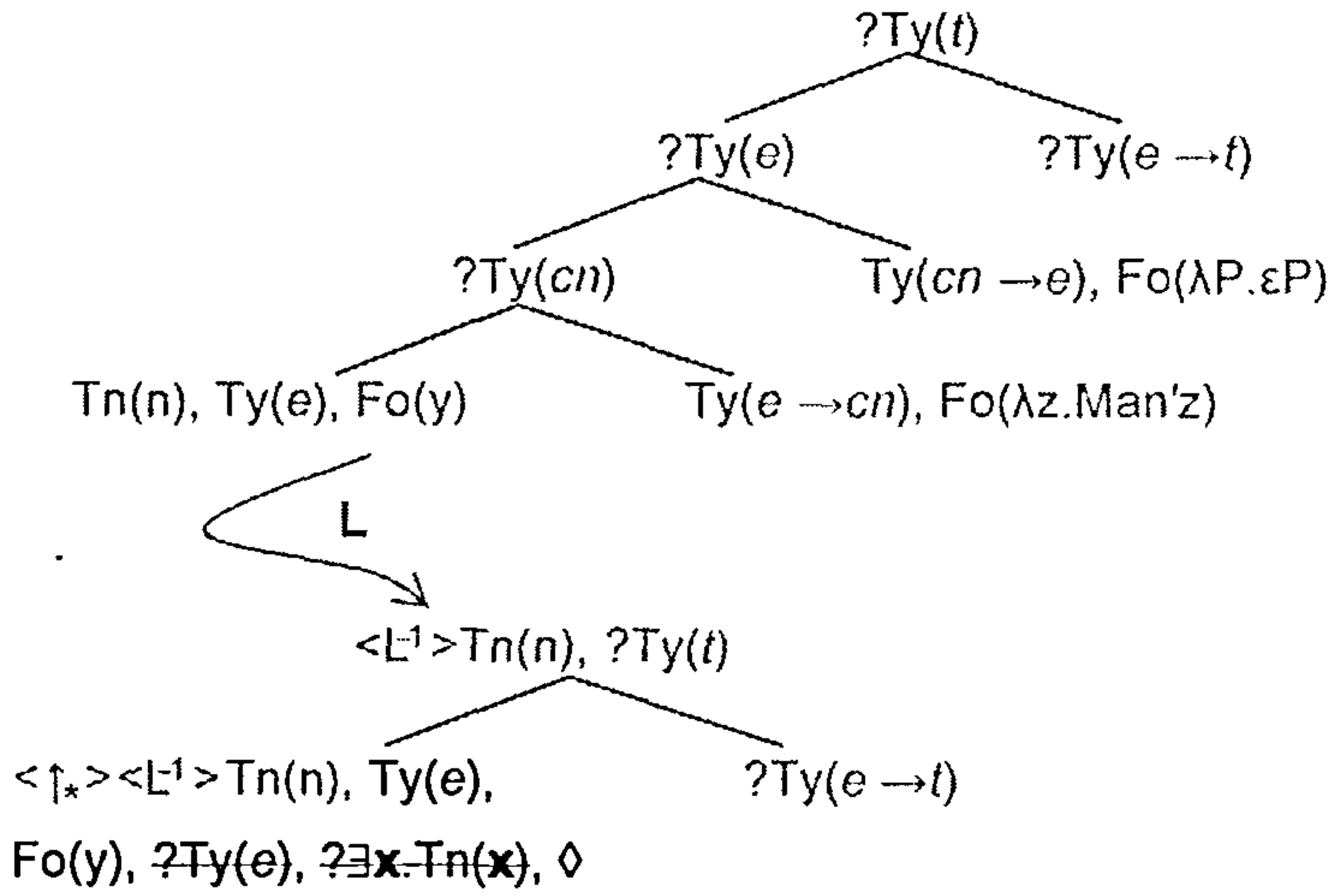
Completion can now move the pointer from the unfixed node to the $?Ty(t)$ node. The requirement for a copy there has now been satisfied and can be deleted. Introduction and Prediction build the subject and predicate nodes and the pointer moves to the subject node. Conforming to the *Normal Form Constraint* the unfixed node comes now to hang under the subject node:

(78)



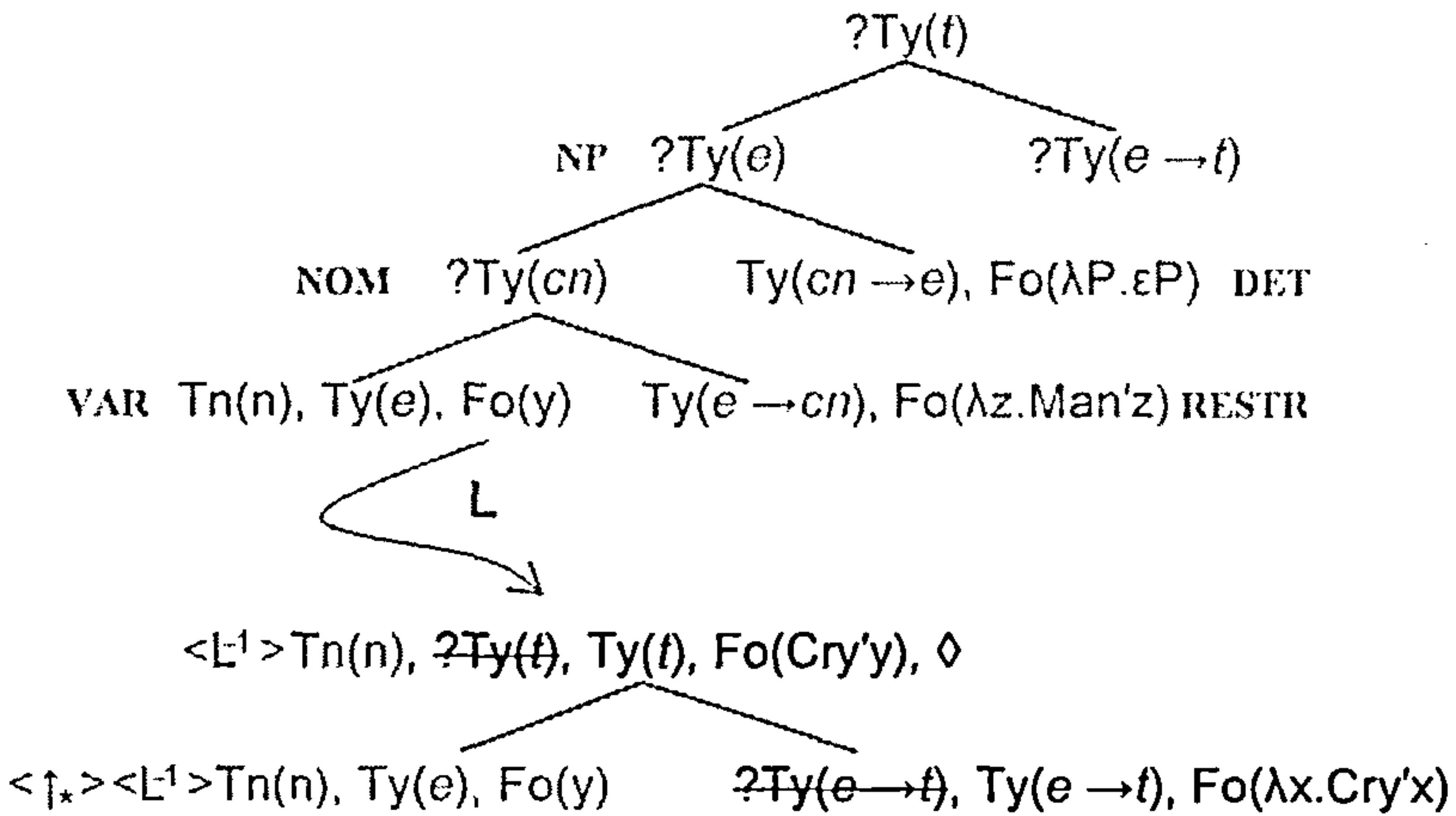
The rule of Merge can now apply to unify the unfixed node with the subject node. The requirement for a proper address for the unfixed node and a type e formula value for the fixed node are now both satisfied:

(79)



After movement of the pointer to the $?Ty(t)$ node by *Completion*, the parsing of the verb inside the relative clause will now decorate the predicate node and *Completion*, *Elimination* and *Thinning* will compile the information inside the LINKed tree:

(80)



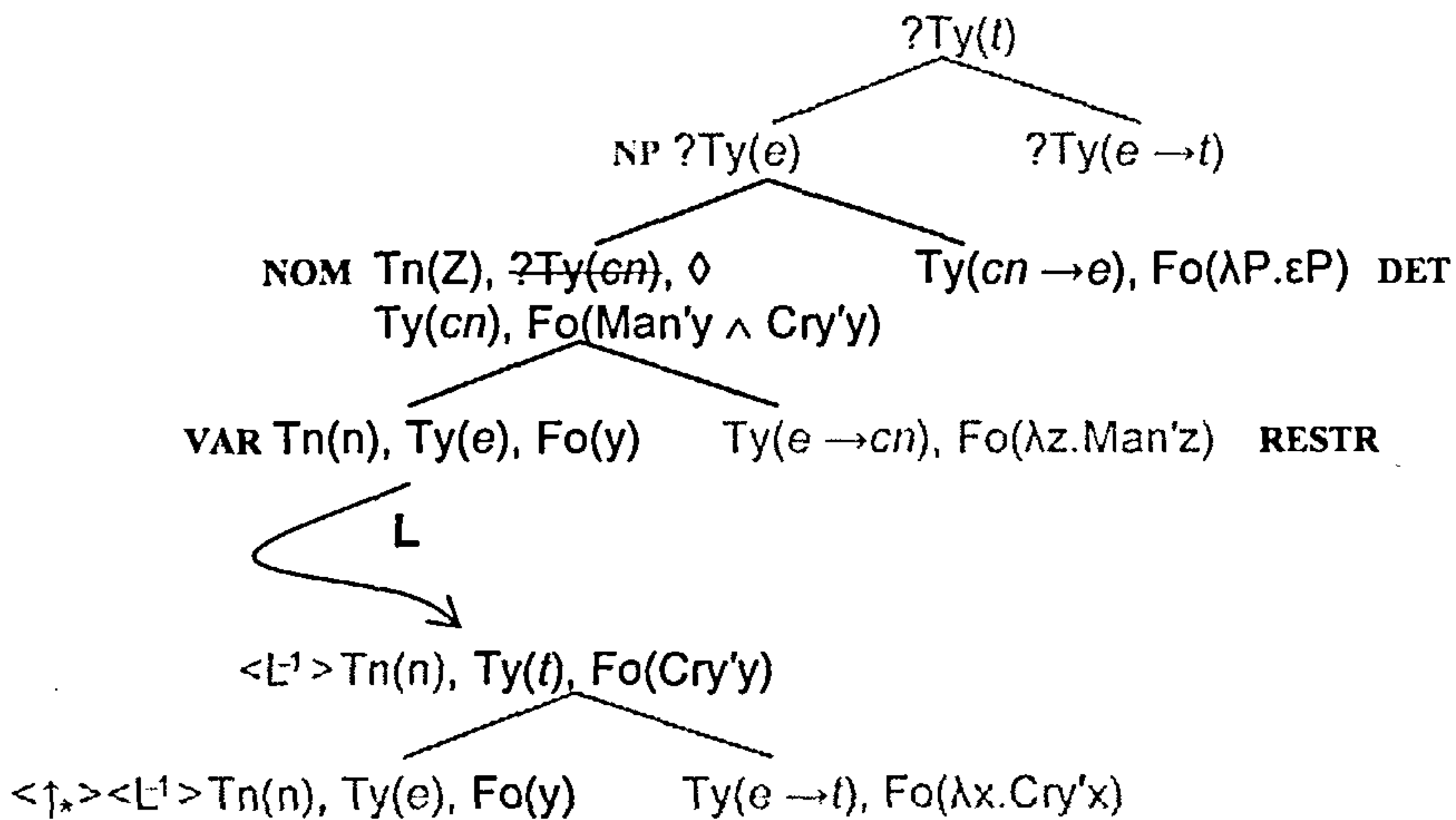
We now need a rule to move the pointer to the *LINK mother* node and integrate the information appearing in the two trees. The effect of this operation will be a new complex restrictor for the epsilon binder occupying the DET node. The rule is as follows:

(81) *Link Evaluation 2 (restrictives)*

$$\frac{
 \begin{array}{l}
 \{ \dots \{ Tn(Z), ?Ty(cn) \dots \} \dots \{ \langle \uparrow_0 \rangle Tn(Z), Fo(x), Ty(e) \}, \\
 \{ \langle \uparrow_1 \rangle Tn(Z), Fo(\lambda z.z, Pz), Ty(e \rightarrow cn) \}, \{ \langle L^1 \rangle \langle \uparrow_0 \rangle Tn(Z), Fo(Q), Ty(t), \diamond \}
 \end{array}
 }{
 \begin{array}{l}
 \{ \dots \{ Tn(Z), Fo(x, Px \wedge Qx) Ty(cn), \diamond \dots \} \dots \{ \langle \uparrow_0 \rangle Tn(Z), Fo(x), Ty(e) \}, \\
 \{ \langle \uparrow_1 \rangle Tn(Z), Fo(\lambda z.z, Pz), Ty(e \rightarrow cn) \}, \{ \langle L^1 \rangle \langle \uparrow_0 \rangle Tn(Z), Fo(Q), Ty(t) \} \}
 \end{array}
 }$$

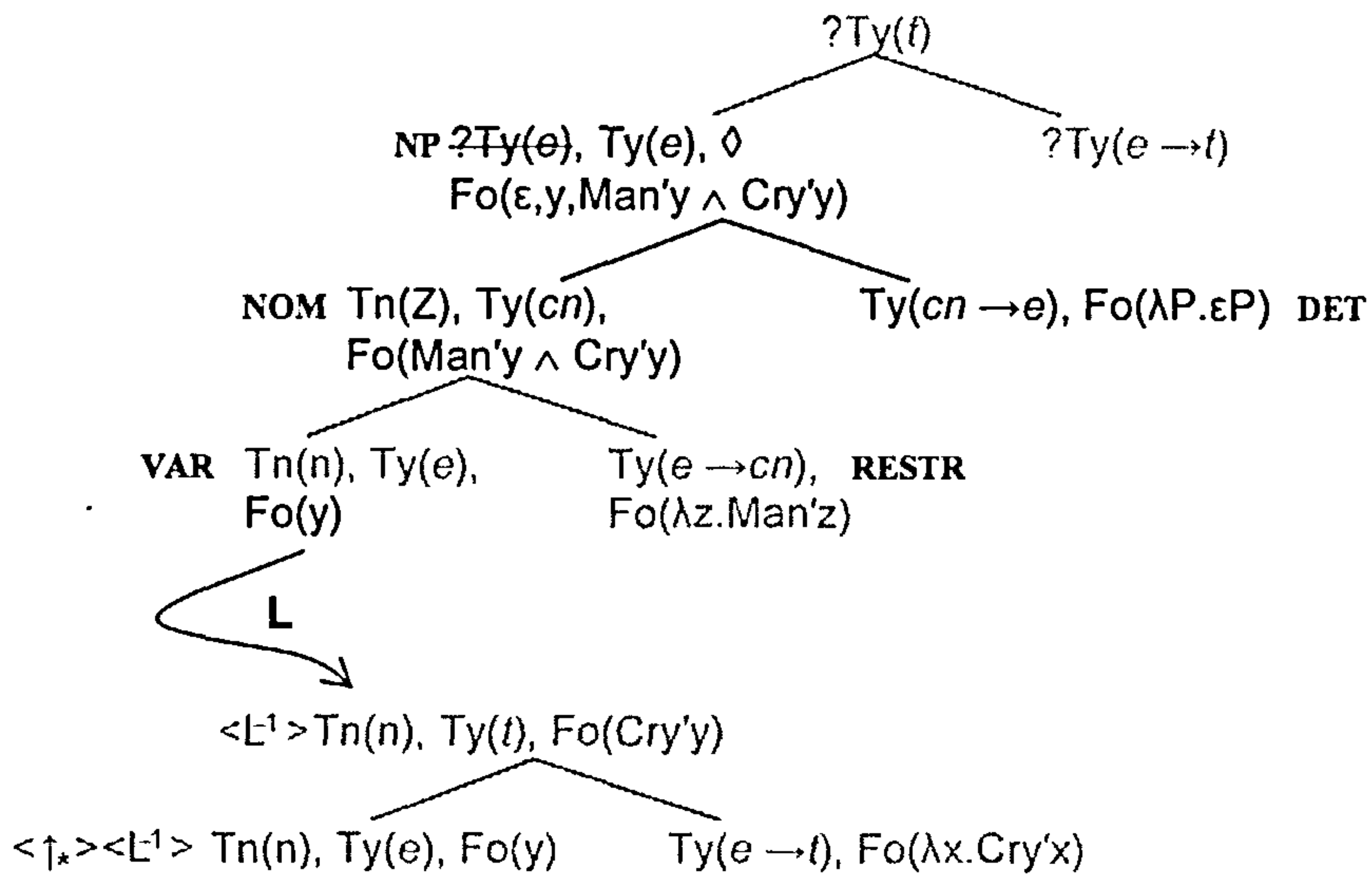
If the pointer is at the root node of a LINKed tree with completed Formula and Type values this rule will move the pointer to the $?Ty(cn)$, NOM, node of the main tree. There a Formula value is inserted which is a conjunctive proposition with a distinguished free variable (\mathbf{x} , $P\mathbf{x} \wedge Q\mathbf{x}$). The actual value of the distinguished free variable will be whatever variable occupies the VAR node (y in the tree in (82) below). The first conjunct of this proposition is the predicate found at the RESTR node applied to the distinguished free variable (Px in the rule, $Man'y$ below). The second conjunct is whatever Formula value occupies the root node of the LINKed tree. Because, by the LINK Adjunction rule, the latter formula is necessarily a predication on the same free variable that occupies the VAR node we have now constructed a complex restrictor for the quantificational binder occupying the DET node:

(82)



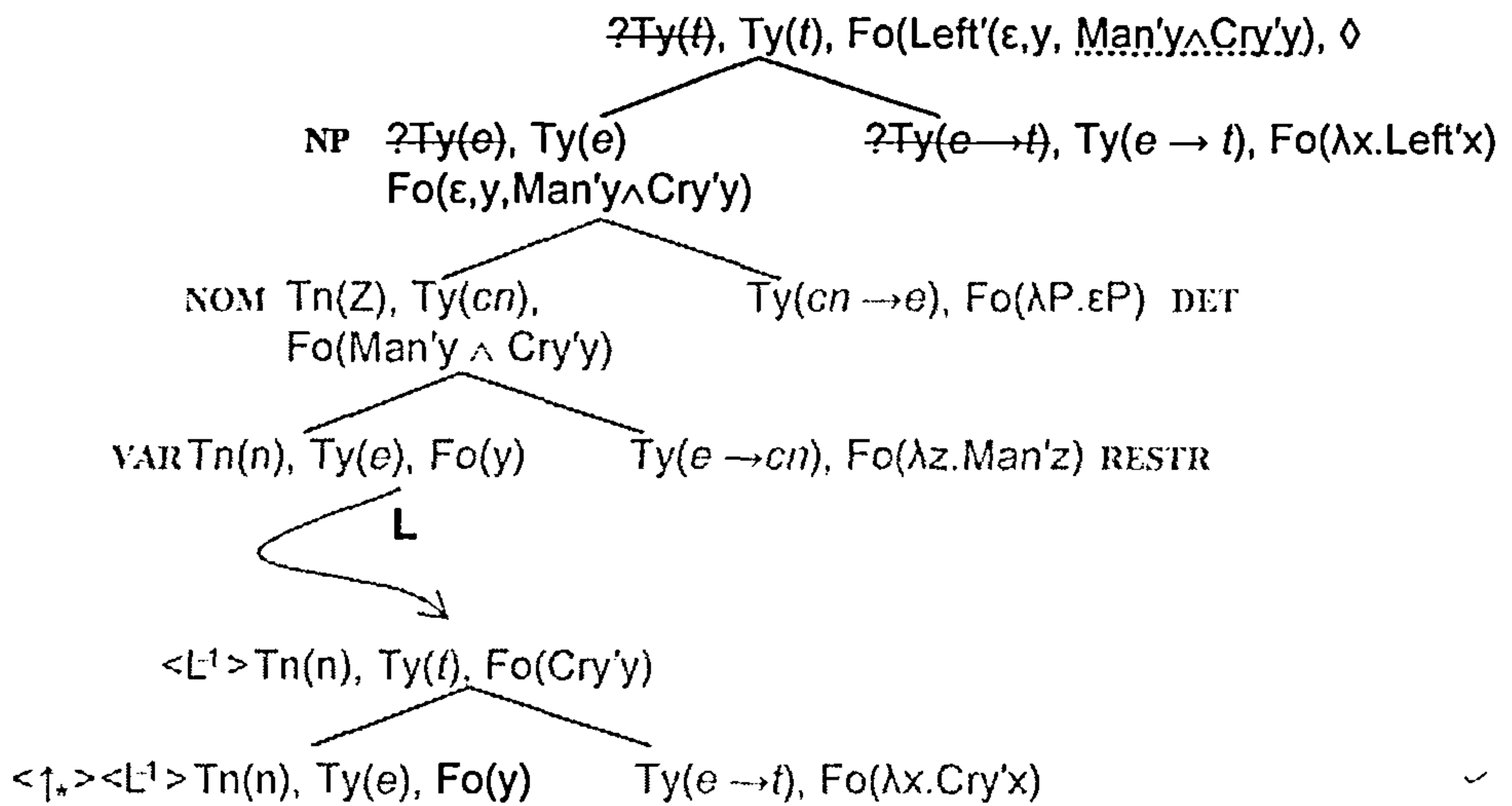
After this, the usual rules apply to compile the information at the NP node and construct the term which is the content of the string *a man who cried*:

(83)

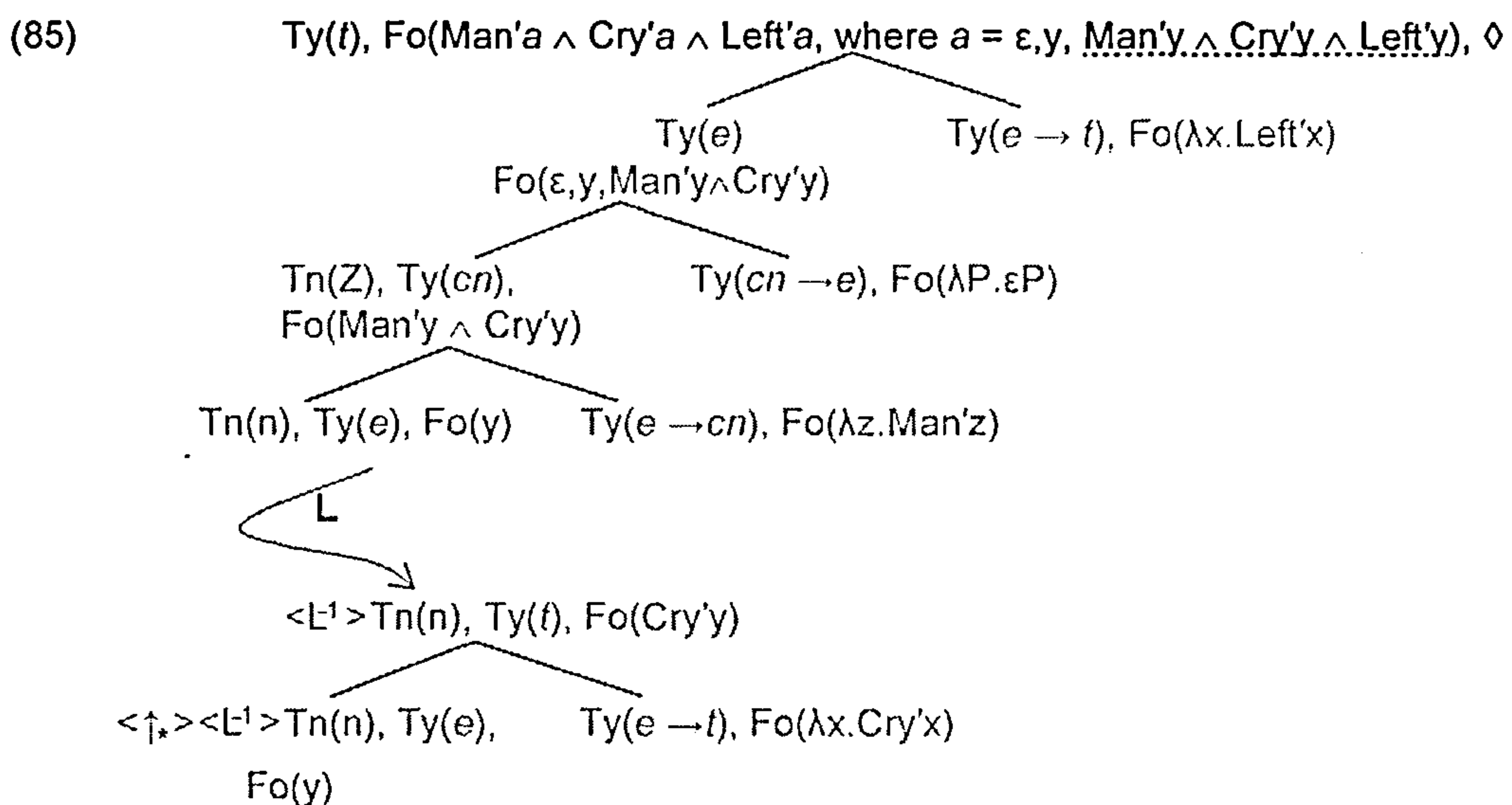


Parsing of the verb *left* will now annotate the predicate node and the Completion, Elimination and Thinning rules will carry out the compilation of the information at the root node:

(84)



The rule of scope evaluation (*Q-Evaluation*) can now apply at the formula decorating the top node of the tree to derive an epsilon term incorporating the predications contributed by the common noun *man*, the verb *left* and the relative clause verb *cried*:



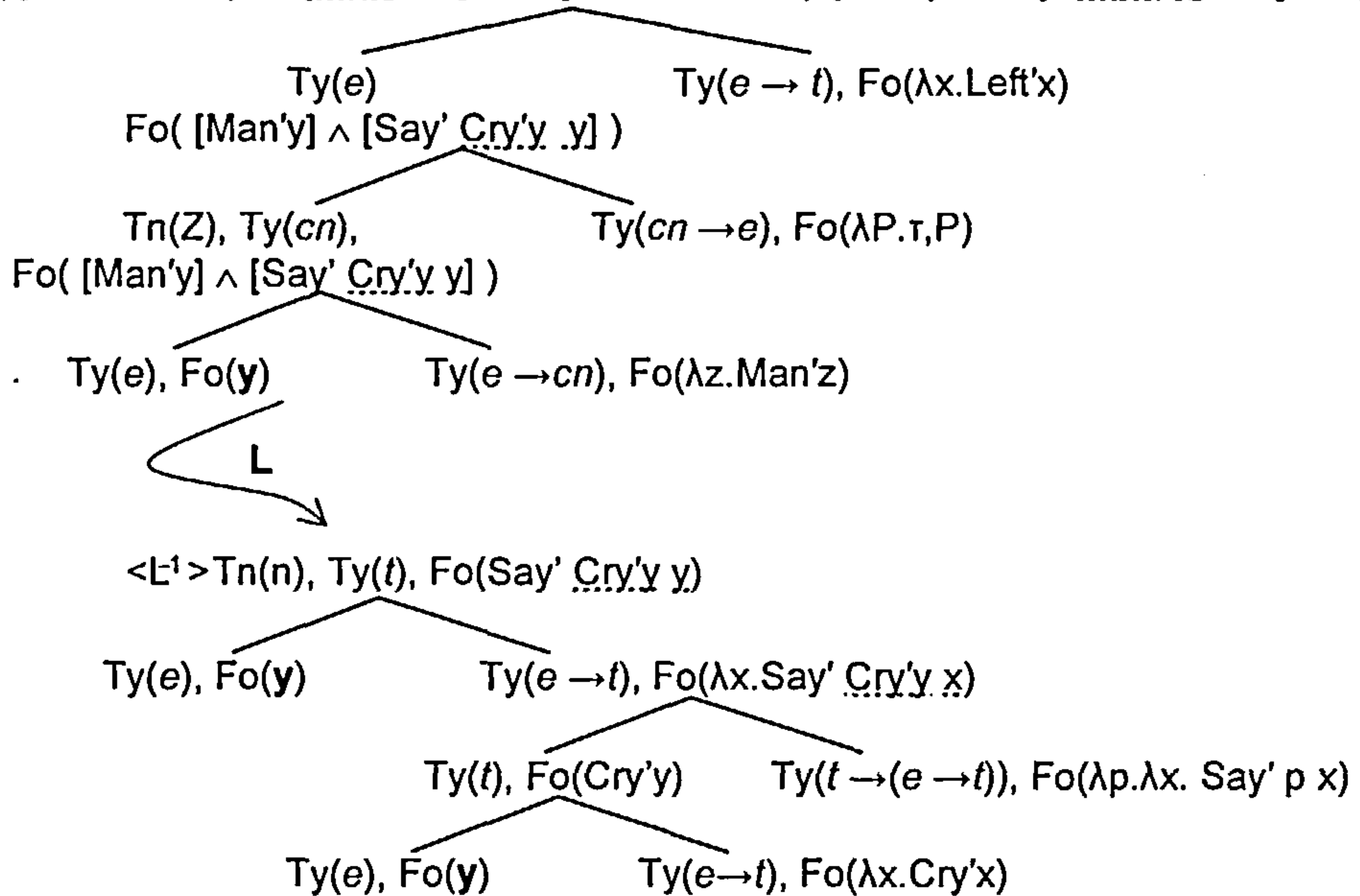
This completes the processing of the sentence with the restrictive relative. We now have a complex term, the term abbreviated as *a* above, which can serve as an element in the context available for subsequent metavariable substitutions, e.g. the metavariable that will be contributed by *he* below:

(86) A man who cried left. *He* was very upset.

In the Heim & Kratzer (1998) framework, a pronoun inside a restrictive relative construed as coreferential with a quantificational head is modelled as involving a distinct use of pronouns as *bound variables*. However, in DS such pronouns are interpreted in the same way as any other pronoun, i.e. by means of Substitution. The replacement for the metavariable contributed by a pronoun which is interpreted as coreferential with the head will be a copy of the variable contributed by the common noun and appear inside the Restrictor of the quantificational term if the relative is restrictive. Such variables are legitimate accessible members of the context since they have just been used in the construction of the NP node. We present the tree derived by a restrictive interpretation for the relative included in the sentence in (87) below. It can be seen that the pronoun *he* is construed as the variable *y* which has been contributed by the common noun *man*. This variable ends up bound by the τ -binder because of the copying of the information in the LINKed structure to construct a complex restrictor at the $\text{Ty}(cn)$ node:

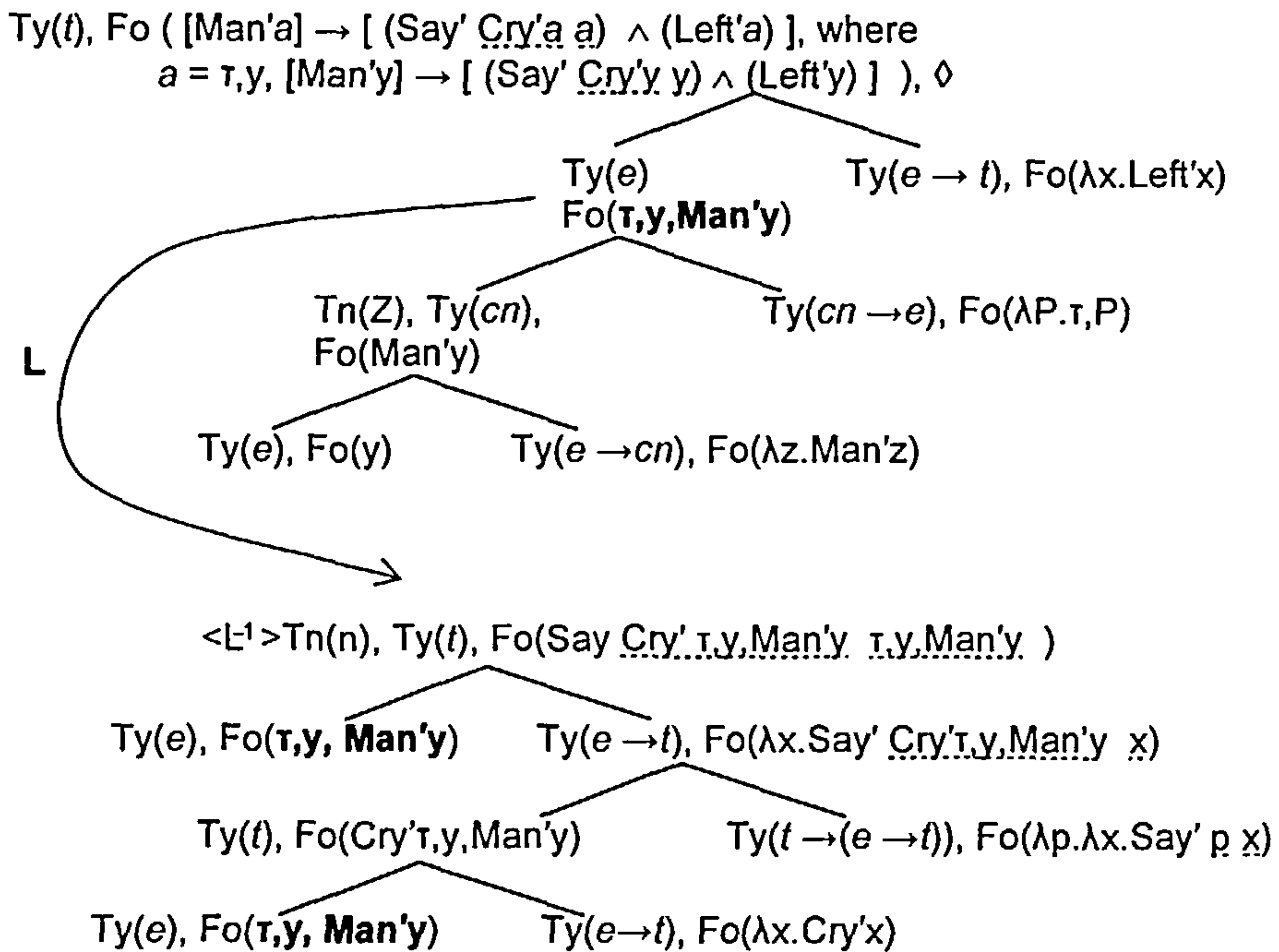
(87) *Every man who said he cried left.*

$Ty(t), Fo([Man'a \wedge Say' Cry'a a] \rightarrow [Left'a], \text{ where } a = \tau, y, [Man'y \wedge Say' Cry'y y] \rightarrow [Left'y]), \diamond$



For the same string, a non-restrictive construal for the relative can be achieved if the LINK relation associates the higher type e node of the main tree with the tree derived from the relative. The effect of this linking is that the incomplete τ -term constructed out of processing the phrase *every man* will be copied inside the LINKed tree. At the last stages of the parsing process the *LINK Evaluation Rule* for non-restrictives will incorporate the content of the relative in the formula value derived at the root node of the tree. Therefore when the *Q-Evaluation Rule* applies the content of the relative will be taken as part of the Nuclear Scope (the consequent of the conditional) inside the completed tau term:

(88) Every man, who said he cried, left.



It can be seen from the above that a unified notion of information copying from one tree to another and the intuitive assumption that anaphoric expressions just provide substitution sites for salient terms can allow the derivation of the requisite truth-conditional effects associated with restrictive and non-restrictive interpretations without employing structurally unprecedented representations or specialised semantic rules. We will employ the same tools in the following chapters that provide, in essence, an analysis of *if*-clauses as restrictive relatives on the situation argument of a propositional tree. This analysis will reconstruct in a dynamic way the widely held assumption that *if*-clauses constitute context-building devices in the form of restrictors for quantificational structures (see e.g. von Stechow 1994).

CHAPTER 5

CONDITIONALS: STRUCTURE AND PROCESSING

1. The tension between coordination and subordination

1.a. The theoretical alternatives

Conditionals present one of a number of cases where there is tension between analyses in terms of the traditional notions of *coordination* and *subordination*. As it was discussed earlier, DS distinguishes only two ways of combining the input provided by the processing of distinct clauses in order to produce a complex proposition as their content:

(a) a clause can contribute the argument of a predicate as in, e.g., the propositional object of a verb; in this case the *local tree* will consist of two predicate-argument structures one embedded into the other, or,

(b) two clauses can introduce two separate trees connected by a LINK relation between their nodes. The latter mode of processing results in an overall structure called the *global tree* which can encompass any number of linked trees and is a representation equivalent to an inferential/cognitive unit (cf. Blakemore 1987, Carston 2002).

As regards the latter option, it must be noted that punctuation indications like full-stops between strings are not taken as significant as in other frameworks where the notion of a *sentential* unit is what is characterised by the grammar. In DS a *global tree* incorporating LINKed trees can result from the processing of two sentences punctuated with full stops among them as well as restrictive and non-restrictive relatives, the processing of adjuncts etc.. In addition to that, as we saw, there is also the possibility of having independent trees as part of the context (the *Discourse Context*, see Cann et al. 2005: Ch. 9) as the construction process crucially interacts with and relies on externally given information. Within this theoretical framework the question that we are going to discuss now is how such a view of semantic representation can account for

the phenomena associated with the processing and the syntactic properties of conditionals.

In providing a structural description for the content derived by processing a conditional structure the following possibilities present themselves within the means that DS makes available:

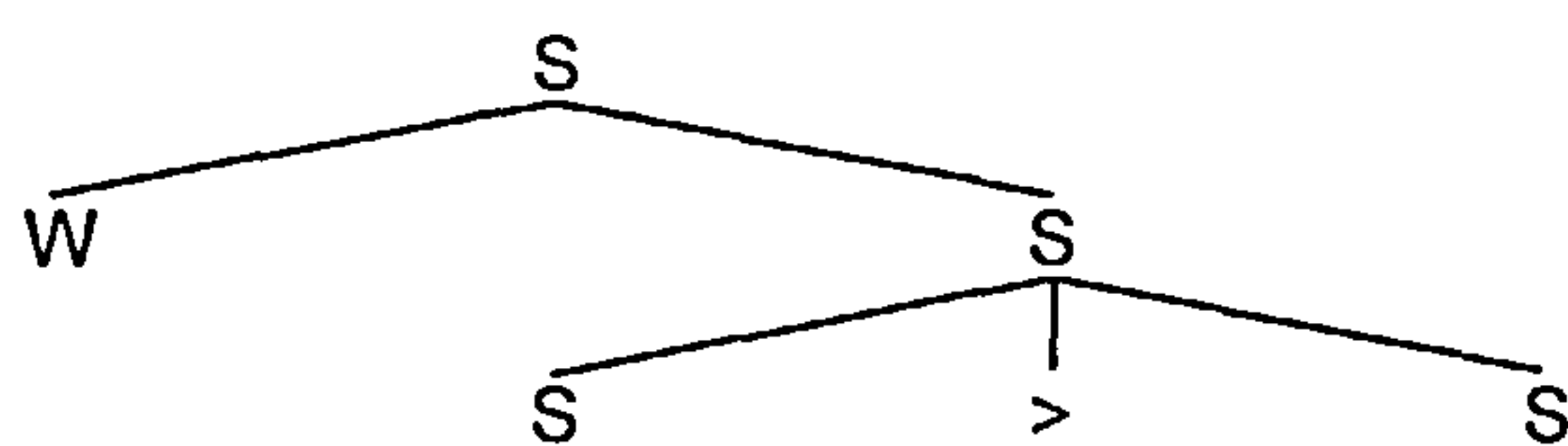
- a. there is an embedding relation between protasis and apodosis as in (a) above. This can be implemented as follows: the content of the particle *if* contributes a functor which takes the content of the two clauses as arguments; the whole structure exemplifies a single proposition with function application relating its components.
- b. the tree derived by processing one clause is LINKed to a tree derived by the processing of the other (as in (b) above). There are two separate possibilities distinguished here:
 1. the root nodes of the two trees are LINKed as in, e.g. the DS analysis of coordinate clauses; two further alternatives are also available here:
 - i. the *if*-clause content is LINKed to the main clause tree
 - ii. the *if*-clause content is inversely LINKed to the main clause tree
 2. there is a LINK relation between a term in one of the trees and the tree representing the content of the other, as in, e.g., nominal relative clauses; another two alternatives are available here too:
 - i. the content of the main clause is LINKed to a term inside the proposition contributed by the *if*-clause
 - ii. the content of the *if*-clause is inversely LINKed to a term inside the main clause.

We now turn to examine the evidence supporting each analysis available to us.

1.b. Parallels between conditionals and coordinate structures

The logical form assigned to a natural language conditional structure under the truth-functional *material implication* interpretation and a compositional view of the syntax-semantics interface implies a logical form where the two clauses are conjoined by a two place connective and are equivalent in status. Under one such possible account, *if ... then* in natural language can be viewed as a discontinuous connective relating two sentences (see e.g. Chomsky 1957: 22, Strawson 1986). Other semantic accounts are compatible with this view too as a lot of the complexity of interpretation can be assigned to the semantic/interpretive rules. Schachter (1972), adopting Stalnaker's analysis of conditionals, provides the following syntactic analysis for counterfactuals (W is the variable representing the world of evaluation and > the conditional connective):

(1)

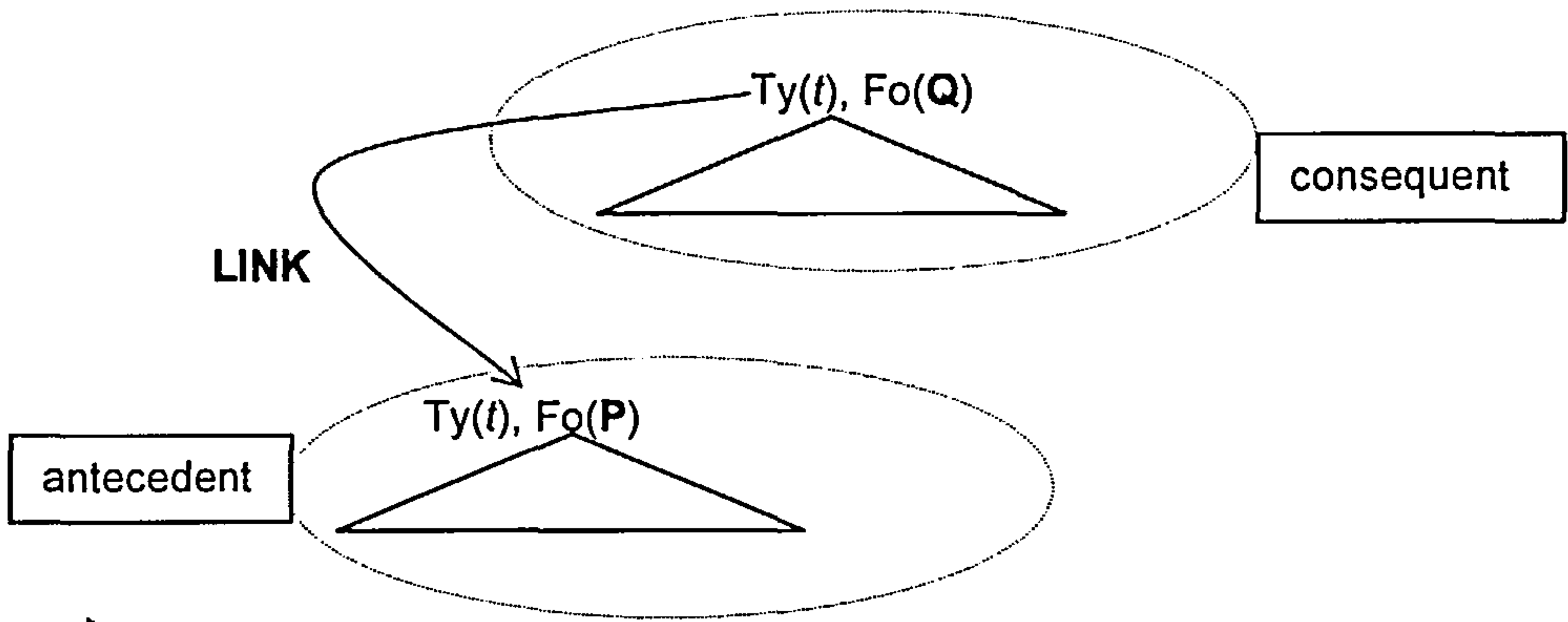


In such an analysis the connective *if...then* is assigned the same syntactic properties as the connective *and*. The representation though, although including an additional element (W) indicating the modal interpretation, is not explicit enough as regards the eventual proposition expressed as there is no overt indication of either quantification over worlds or the selection function/accessibility relation etc (and in the case of indicative conditionals the assumption is that the variable W is missing). For us this means that, since we do not assume a separate syntactic structure for the string which is then compositionally interpreted, adopting a similar representation will make the logical forms proposed (LOT representations) to be reliant on a powerful semantic component or to unrestricted pragmatic free enrichment⁵³ to derive

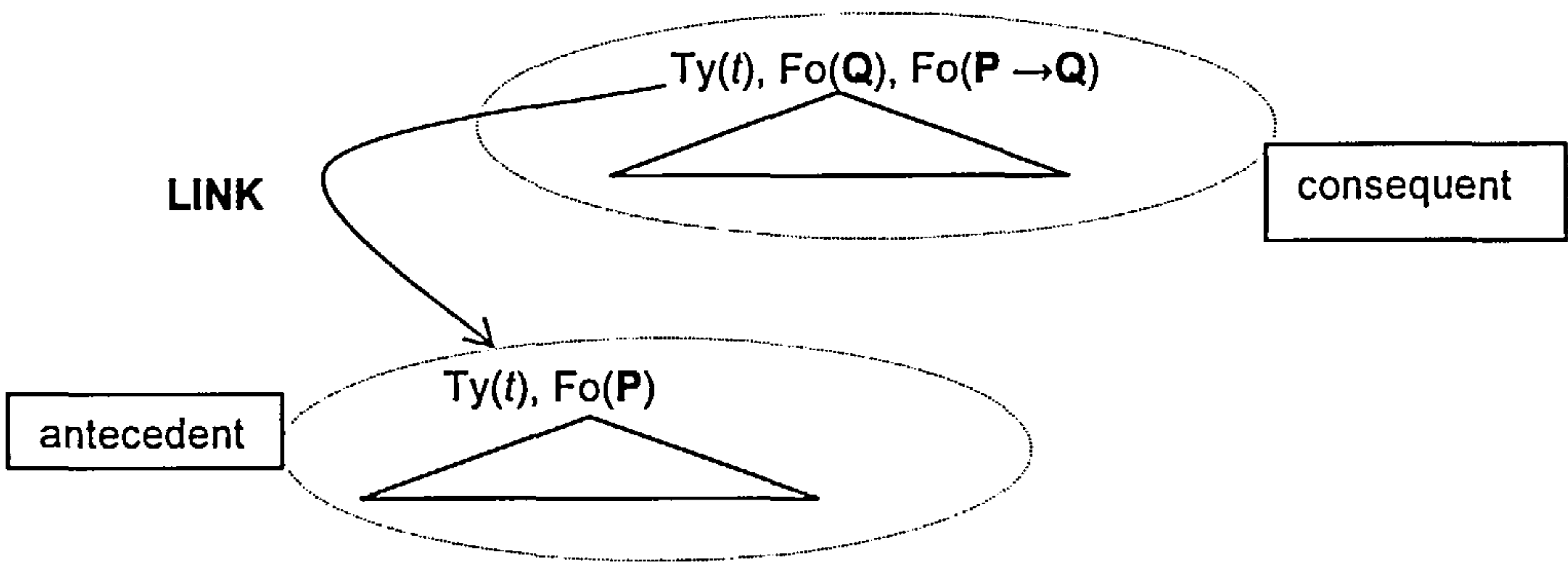
⁵³ For the distinction between free enrichment and saturation see, e.g. Carston 2002

the desired proposition expressed. However, the syntactic evidence that we saw in Chapter 1 and will see again below seem to show that natural language forms are more transparent than that. Moreover, structurally a similar analysis is not directly available in DS since binary branching is taken for granted. However one legitimate expression of the spirit of this analysis in a DS logical form would be a structure similar to that arising from coordinate structures. The propositional content of protasis and apodosis could appear as a pair of LINKed trees and an appropriate (conditional) *LINK Evaluation* rule would be invoked to derive the implication relation between the two propositions (notice that copying of information from one tree to another implies some form of subordination of one propositional content (the copied one) to the other):

(1) The tree initially derived by parsing if P then Q:



(2) Application of Conditional *LINK Evaluation Rule* \Rightarrow



There are a few technical problems with such an analysis, for example the fact that the lexical item *if ... then* that is supposed to induce this structure is discontinuous or the fact that there is no overt shared term between the two structures, a typical hallmark of the LINK relation⁵⁴. Another more substantial problem is the weakening of the formula value at the root node of the tree derived by the consequent: unlike what happens in structures related by *and* where the effect of the *LINK Evaluation Rule* is cumulative, in the structure above, the parser, having derived *Q*, applies the putative *Conditional LINK Evaluation Rule* which will induce another formula value $P \rightarrow Q$. The latter can be seen as a partial retraction of the original formula value⁵⁵. Although such non-monotonic inference processes are legitimate outcomes of pragmatic operations it is not certain that they should be induced by the computational actions of a monotonic grammatical formalism. This is especially important for DS where there is no assumption that there is a temporally prior stage of the entire structure being derived first by the parser and then being submitted for pragmatic processing: the incremental, dynamic nature of the structure building process interacts on-line with the equally dynamic inference and integrating processes defined by relevance theoretic frameworks. From the point of view of explaining the efficiency of deriving appropriate inferences on-line, it seems much more appropriate that the parsing mechanism will not provide initially misleading evidence, which has to be retracted (the problem is more acute in cases where the *if*-clause follows the apodosis since there a look-ahead mechanism induced presumable by the processing of *if* would not be available).

Supposing that these problems could be overcome (for example by an appropriate analysis of *then* and with the appropriate LINK Evaluation rules) it

⁵⁴ In cases of propositional coordination we could assume a shared situation argument.

⁵⁵ There is another technical problem here in that, since all rules are optional, there is nothing to force application of the putative Conditional Link Evaluation Rule. This is harmless in the case of non-restrictive relatives where the two trees have relatively independent content but in the case of conditionals, provisions will have to be made so that we do not end up with a representation implying the semantic interpretation of conjunction. Although this might seem a mere technicality, it shows that the connection between the antecedent and consequent is something that goes beyond mere juxtaposition of propositional contents.

could be assumed that words like *and*, *or* and *if* contribute conceptual content very nearly identical to their analysis as connectives of the propositional calculus and induce the building of logical forms that reflect the fact that two independent propositions have been uttered (plus the appropriate relation between them). However, we saw in Chapter 1 and we are going to see again later that there are some hints in the behaviour of *if*-clauses that indicate the subordination of its content to the propositional content derived by the consequent, for example, the *if*-clause cannot bear independent “illocutionary force” indicators, it can appear in any position with respect to the main clause etc. In that respect, notice that, although there is a hint of an asymmetry between the clauses in the representation in (2) (what is copied where), there is no real justification for making any non-stipulatory decision as to which of the two trees should be taken to accommodate the final formula (especially since the linear order of antecedent-consequent varies). The same problem could be said to arise with coordination but it could be argued that there the problem is only apparent since, unlike in the case of non-restrictive relatives, there are reasons to apply the *LINK Evaluation Rule* so that content is copied across to the initial tree (see also Humberstone 2005: 557-559); compare, e.g.:

- (3) John believes that Mary is my friend and she is angry with me.
- (4) John believes that Mary, who is my friend, is angry with me.

Cases parallel to (4) arise with conditionals too but the point is that because of the linear order freedom the structures in (1) and (2) do not provide adequate justification for which one is the main structure where the propositional content has to be copied. Where the problem appears to be similar is the case of restrictive relative clauses. There are significant reasons for assuming that the content provided by the relative clause is accommodated inside the tree derived by the processing of the main clause, and for this reason DS makes provision for the appropriate rules to be available (and this is not only because of the linear order of such structures in English but also because of truth-conditional and pragmatic effects). Therefore what we need to consider now is whether *if*-clauses pattern with

relatives or co-ordinate/juxtaposition structures. We are going to see, as has been pointed out by many researchers (see, e.g. Haiman 1978, Geis 1985, Lycan 2001), that there is linguistic evidence against a parallel analysis of *and* and *if*, and that the content of the *if*-clause plays an auxiliary role in the processing of the consequent. This evidence also indicates that the content of natural language sentences cannot be directly mapped to predicate or propositional calculus formulae (and given that these calculi are artificial languages devised by logicians in order to overcome the “complexities” of natural language there is no reason to expect a direct mapping anyway).

2. Coordination and Subordination structures

It is usual in frameworks that maintain the traditional distributional analyses assigning structure to strings of words to postulate that *coordination* and *subordination* can be sharply distinguished as exemplifying two completely distinct modes of combination. Under such analyses, the coordination mode relates two components with symmetric properties and no dependency of one on the other whereas subordination relates components associated by a dependency relation so that an asymmetry between them ensues (see e.g. Matthews 1981: 195-198). In these frameworks there are criteria for establishing whether a clause can be taken as subordinated or coordinated. Although these criteria do not have the same status from a DS point of view, we will examine those that have been applied to the identification of the status of *if*-clauses and we will consider whether, under a reinterpretation in DS terms, they support the above purported DS analysis of conditionals or not.

2.a. Coordination or Subordination: the Evidence

Geis (1985), Lycan (2001) and Iatridou (1991) compare the syntactic properties of coordinate structures and conditionals and conclude that *if*-clauses should be characterised as subordinated to the main clause (consequent). Although this evidence is examined in order to justify some proposed constituency structure for the sentential string itself, since this

constituency structure is many times motivated by semantic/pragmatic considerations, we can find evidence here that is pertinent to a DS analysis too. One such piece of evidence is the fact that *if*-clauses, like most adverbial adjuncts, can occur in various positions, before the verb, post-verbally and even left-dislocated unlike coordinated clauses:

- (5) If John cries Mary leaves
- (6) Mary leaves if John cries
- (7) If John cries Sue said Mary leaves
- (8) John cries and Mary leaves
- (9) *And Mary leaves John cries
- (10) *And Mary leaves Sue said John cries

This could be taken to indicate that *if* introduces a proposition that does not have to be necessarily processed and integrated after the content of the consequent clause has been derived, in fact it is very frequent for things to be the other way round (but not always, so we cannot take the consequent as parallel to the second conjunct in coordination). On the other hand, if we take the *if*-clause as providing content essential for the processing of the main clause (similarly to the way restrictive relatives provide content essential for the processing of the main clause) these facts can be explained in that the content of the *if*-clause must be integrated and constitute part of the proposition derived by processing the consequent and this is clearly indicated by the presence of the lexical item *if* marking which clause provides the auxiliary content⁵⁶. Notice however that the same argument does not go through when the adverb *then* is used in the consequent:

- (11) If Mary cries then John leaves
- (12) # Then John Leave's if Mary cries

So this evidence does not necessarily completely disconfirm the discontinuous connective *if-then* view discussed above. One might assume that there is a rigid structural arrangement and in cases of clause-initial *if*-clauses where *then* is not involved an implicit secondary connective might be

⁵⁶ The phenomena of order flexibility are not untypical of relative clauses either: there are extraposed relatives in English and there are also correlative structures in many languages. Needless to say that this is also the case for adverbial clauses cross-linguistically.

postulated with postverbal *if*-clauses presenting something like a revision of what has been said. This does not seem as an immediately plausible analysis, although postverbal *if*-clauses have been assumed by some researchers to have distinct significance from preverbal ones and one might interpret their claims as requiring a “grammaticised” topic-comment structure for conditionals (for the distinct pragmatic interpretations assigned to postverbal and preverbal *if*-clauses see Ford 1993, Dancygier 1998: 145-159). However, it is not necessarily the case that there are such *encoded radically truth-conditionally* distinct interpretations between the two structures and therefore we are not going to assume that anything more is going on beyond distinct order of processing with pragmatic consequences. The issue of the contribution of *then* will be discussed further in the next chapter where we will see that the rigidity of word order in these cases is as expected according to present and general DS assumptions. For now we will look at another set of arguments which show that certain phenomena appear in coordinated structures whereas they are excluded in conditionals. The explanation of these phenomena also casts doubt on the putative analysis presented in (1) and (2).

First of all, two clauses related by the conjunction *and* can undergo certain structural reductions which are not possible in other constructions. For example, the two conjuncts can be made to share a common subject (*Conjunction Reduction*). This is not possible between antecedent and consequent in conditionals:

- (13) John [bought the newspaper] and [sold the milk]
- (14) *John [bought the newspaper] if [sold the milk]
- (15) *If John [sold the milk] [bought the newspaper]

Moreover, the phenomenon of *Right Node Raising* is precluded between antecedent and consequent:

- (16) John will support _ and Mary will try to promote _, the manager of their department
- (17) *If John supports _ Mary will try to promote _, the manager of their department
- (18) *[Mary will support _] [if John tries to promote _], the manager of their department

The phenomenon called *Gapping* can occur between two coordinated clauses: the verb of the second clause can be elided if it is identical to the one in the first one:

(19) John *will buy* the newspaper and [Mary _ the milk]

There is no corresponding construction for *if*-clauses:

(20) *John *will buy* the newspaper if Mary _ the milk

Coordinated clauses exhibit the phenomenon of *Across-the-Board* extraction which is usually analysed under some requirement for symmetry between the two clauses (see, e.g., Smith & Cormack 2005),:

(21) The man who [John dislikes _] and [Mary loves _] came to see me yesterday
 (22) Who [did John dislike _] and [Mary love _]?

On the other hand, extraction from a single conjunct is not allowed:

(23) *What did John see ___ and Mary confronted him?
 (24) *Who John saw Sue and Mary confronted ___ ?

In contrast there is no such symmetry requirement in a conditional: The antecedent of a conditional does not allow extraction at all whereas the consequent can be extracted from freely:

(25) *Who if Mary likes ___ will John be upset?
 (26) The man who if Mary likes ___ I will be upset...
 (27) *Who will John be upset if Mary likes ___?
 (28) Who will be upset if Mary likes Bill?
 (29) If Mary likes Bill who will be upset?

Lastly, the focusing adverbials *even* and *only* can combine with *if*-clauses but not with *and* conjuncts:

(30) Only if John works hard does Bill work hard
 (31) Even if John works hard Bill works hard
 (32) John works hard and Bill works hard
 (33) *John works hard only and Bill works hard
 (34) * John works hard even and Bill works hard

Although these indications of structural contrast has been adduced in the context of frameworks that explicate them in terms of the structure assigned

to strings (*GPSG*, *GB* or *Minimalism*), the contrasting behaviour exhibited by *and*-conjuncts and *if*-clauses is no less problematic for the putative DS analysis of conditionals illustrated in (1) and (2). DS aims to explain such phenomena as either following from the (dynamic) construction procedures for tree structures or by the (static) properties of the structures eventually achieved. Since in DS coordinated clauses are analysed as LINK structures (see Cann et al. 2005, Cann et al. 2003) the parallel structure assigned to conditionals in (1) and (2) above does not allow us to resort to (static) structural properties of the representations constructed in order to explain these contrasts. So if one wanted to maintain a straightforward analysis of *if...then* in parallel with *and*, *or* and *but* it would have to be shown how these systematic differences in the behaviour of the clauses linked by them occur in terms of the procedural means provided. There are two avenues to be explored in order to explain these differences. Firstly, it could be claimed that it is a lexical property of *and*, *or* and *but* that they induce those phenomena and this contrasts with the lexical properties of *if* or *if...then*. This solution seems ad hoc in the context of the analysis in shown (1) and (2) because it is not at all obvious what would motivate such distinct lexical properties cross-linguistically, especially if the semantics is assumed to be truth-functional for all these connectives. It is also liable to cause a lot of redundancy in the grammar since every general rule will have to check whether the input context has been contributed by an *if*-clause or an *and*-conjunct. Additionally to account for the above phenomena the lexical entries of those items will presumably have to make reference to what computational rules could or could not apply either before or after they have been encountered and since separate predicate-argument structures are involved this will require a lot of anticipatory provisions. Although it is not in principle impossible to coordinate things this way, it does not seem a desirable solution and it does not explain the cross-linguistic validity of the above distinctions between coordinate structures and (explicitly marked) *if*-clauses (cf. Haiman 1986). The alternative solution, that will be adopted here eventually, is to attribute the distinctions above to the fact that the propositional content of an *if*-clause is

not directly linked to the main structure (therefore we also give a (static) structural characterisation of the distinction between coordination and conditionals), and direct linkage can then be taken as a requirement for phenomena like *Conjunction Reduction*, *Right Node Raising* etc. to appear (see e.g. Cann et al. 2002, 2005). It is then possible to obtain a derivative differentiation between coordination and other structures. For example, as we will see below, many properties of *if*-clauses are shared with relative clauses which also contrast in similar respects with coordinate structures. Notice, for example, that there is no *Right Node Raising* out of relative clauses:

- (35) John will support _ and Mary will try to promote __, the manager of their department
 (36) *John [who initially supported _] finally fired __ the manager of their department

Although both relatives and *and*-conjunctions involve LINK structures at some point, according to the DS analysis, it is the distinct overall structures assigned to the propositions derived from coordinated conjuncts as opposed to those for relatives which accounts for the impossibility of (36) (see Cann et al. 2002, 2005). Additionally, the fact that there are no “extraction” phenomena from a relative clause to the main clause is also accounted for in DS as the result of structural restrictions on the application of rules that make reference to the tree relations holding among nodes:

- (37) *Who the man who likes _ will be upset?

Under this light, it seems preferable to assume that even though DS does not make any reference to a subordination-coordination distinction in terms of structure defined on strings, nevertheless, it allows for some derivative notion, not as sharp as in traditional frameworks, to be defined in terms of three parameters: (a) the order of processing of distinct units of information, (b) the constituent structure of the resulting logical form, (c) copying of information derived at one tree to another tree. Under this assumption, we will put aside the analysis in (1)-(2) above and we will now examine what kind of “subordination” relation, with respect to these parameters, can be assumed to hold between the propositions derived by the antecedent and consequent in a conditional.

3. Subordination: the options

3.a. The *if* as a functor subordination analysis

From one point of view, the two propositions related in a conditional structure can be taken as the two arguments of a binary functor symbolised neutrally here as: \rightarrow . Stalnaker (1968) talks about the “conditional function”, “a function, usually represented in English by the words ‘if...then’, taking ordered pairs of propositions into propositions” (1968: 98). An appropriate logical form for such an analysis of the meaning of the connective is shown below:

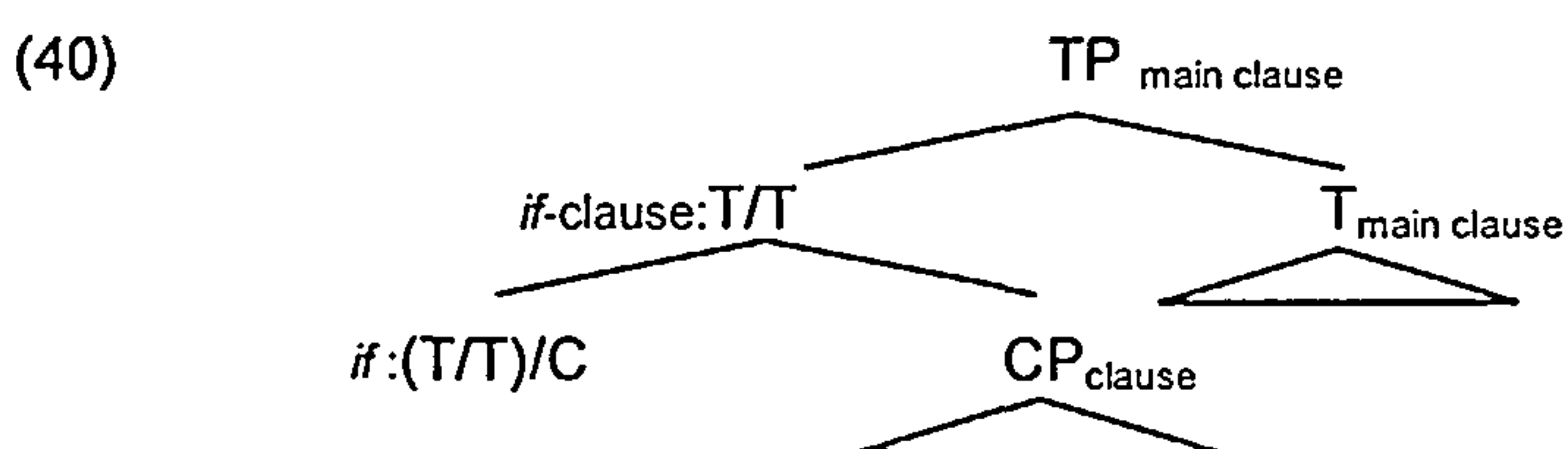
- (38) If John comes, Mary will leave
 (39) $\rightarrow(\text{Come'John'}, \text{Leave'Mary'})$

A compositional interpretation of such a logical form under a possible world semantics will make reference to alternative possibilities which are not represented in the object language. As we said above, such interpretations require a significant amount of free enrichment of the encoded content if they are to be sustained. Under a truth-functional semantics (not espoused by Stalnaker), this type of structural analysis of conditionals is also what underlies the material implication interpretation of \rightarrow in propositional/predicate logic. What matters for the semantics of such a structure is the truth of each conjunct and their order of combination with the functor. Since the order of combination of the two arguments with the functor matters (as for example it matters when a transitive predicate combines with its subject and object), we can immediately derive a semantic asymmetry between the two propositions (although the extent of the *required* asymmetry can be said to not be adequately represented in such logical forms). This asymmetry could be seen as the basis of explaining some of the distinctive properties of *if*-clauses: the combination of the functor translating *if* and the first propositional argument applies to (and “subordinates”, takes as an argument) the proposition derived from the second clause (although notice that this will not necessarily derive any distinction with regard to coordinate structures as those could also be taken to display exactly the same functional analysis). Over the years the material implication semantics attributed to such structures has been

criticised (see Gazdar 1979) but some of the arguments against it can be rebuffed especially if one takes into account Gricean principles of communication, relevance-theoretic notions of inference or any other pragmatic theory that purports to explain the added significance attached to natural language conditionals. On the other hand, of course, independently of the material implication semantics, the fact that the formal languages constructed by logicians happen to express conditional propositions under a similar structural analysis is not an a priori argument that this is the appropriate minimal representation underpinning the semantics of natural language conditionals. Nevertheless, the fact that the material implication interpretation does not seem to account for all the effects associated with natural language conditionals does not provide a knock-down argument against this structural analysis derived from propositional logic, especially when combined with an adequate pragmatic theory like Relevance Theory (see Smith 1983 and Smith and Smith 1988). But notice also that, from our perspective, this analysis does not bear the usual advantage that it has in more standard frameworks, i.e., postulating less “hidden” constituents in natural language syntax. Since here we do not assume any syntactic structure for the linguistic string beyond the time-linear order of presentation we do not face the problem of having to defend implicit elements in the syntactic structure of the natural language *sentence* (cf. Stanley & Szabo 2000). As long as such elements are shown to be essential for the eventually derived semantic content, the only contention, from the current perspective, is how much of the burden of deriving the correct representation we have to allocate to the linguistic system as opposed to general pragmatic principles and free enrichment. What we seek to posit is a minimal, underspecified structure that will provide the appropriate input to pragmatic processing. However, as we eschew any other explanatory mechanisms beyond the syntactic structure assigned to logical forms and the process of constructing those, there remain linguistic phenomena that have to be accounted for. The latter consideration might force us to adopt a logical form that is more explicit than what one would expect as a consequence of assuming a powerful

syntactic framework in combination with a powerful semantic/pragmatic module since here we can only exploit a single level of representation. We start though with a minimal structural proposal, namely, that the processing of natural language conditional sentences induces a function-argument structure as its logical form. This has been defended in the literature as a plausible structure and seems to be compatible with the general requirement to avoid postulating implicit elements if the data can be accounted for otherwise.

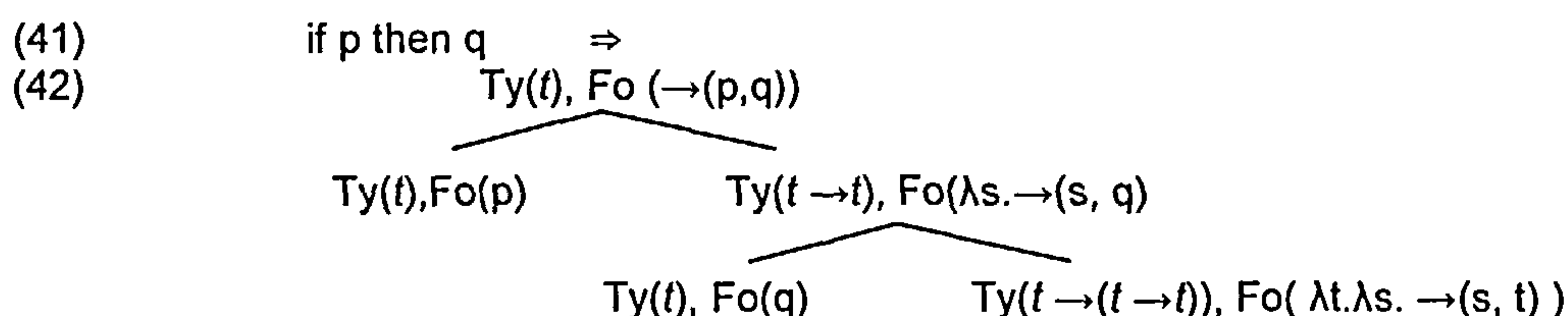
Cormack and Smith (2005) assume that *if* is a subordinating operator⁵⁷ taking two clauses as its arguments. Similar analyses employing the *if*-as-a-functor assumption in a deep structure representation or (intermediate) LF is also found in Rivero (1972: 210) and Boeckx (2003). As we said, at first glance, this assumption makes the syntactic structure assigned to conditionals seem as minimal as possible which is a desirable feature. However, the fact that syntactically the *if*-clause appears to have different status to that of the consequent, indicated by all the asymmetries noted above between the two clauses, is expressed in Cormack & Smith (2005) by an unprecedented structural assumption: the main clause, although being in fact the (second) argument of the operator *if*, nevertheless projects its own category at the mother node:



Given that this proposal is expressed within a framework that assumes a separate syntactic component, this provides the basis for explaining (some) of the asymmetries. For our purposes, as in DS we do not explain syntactic asymmetries by means of logical form structure alone we can consider the

⁵⁷ In fact they suggest that *if* and *then* are probably “agreement” markers agreeing with an invisible conditional operator \supset .

structure above as a candidate for an appropriate DS logical form if we find a way of explaining the asymmetries noted in terms of the procedural mechanisms of construction of such representations. In support of this assumption, one should note that, arguably, the language of thought LOT includes a *modus ponens* rule (see e.g. Sperber and Wilson 1995). Therefore some implication connective \rightarrow is part of its syntax⁵⁸ (whatever the exact interpretation of this connective has to be taken in LOT). The question that arises in this respect for DS is whether there is a direct encoding of such a connective in natural language. What this would mean in DS terms is that the tree that is generated by the parsing of natural language conditionals reflects the articulation of the formula derived at the top node in terms of functor-argument relations. A suitable re-interpretation of the Cormack & Smith analysis would be as follows (simplifying somewhat):



In reflecting on whether this analysis is appropriate it is relevant to consider the fact that the connective \wedge is also taken by DS to be part of the syntax of LOT. DS “translates” a construction containing a main clause and a relative as deriving conjoined propositions⁵⁹ and the same goes for *and*-coordinated

⁵⁸ Any logical system based on propositional logic does not necessarily have to have the full set of connectives since it is well-known that these are inter-definable. Therefore seeing LOT at a more abstract level as the language at which inferences are performed, irrespective of how those are expressed in natural language, it could be claimed that the existence of multiple connectives in artificial formal languages does not provide evidence that the same connectives can be found in LOT. This would be especially pertinent in cases where the natural language evidence suggests a different analysis than the one assigned to propositional logic connectives. For example it could be claimed that we can do with only conjunction, \wedge , and negation, \neg , as LOT connectives. Then a conditional string *if P (then) Q* will be mapped to a LOT sentence of this form: $\neg(P \wedge \neg Q)$. The truth-functional/material implication analysis of natural language conditionals is compatible with such a possibility. The encoded semantics assumed here not necessarily so.

⁵⁹ This analysis has implications for the status of tree representations in DS and the characterisation of LOT: Conjoined propositions are derived at the root node of the *global tree*. Since there are no *conjoined trees* only *conjoined formulas*, the trees must be simply the means for deriving the LOT formula and LOT inference must be defined over root node

and juxtaposed structures. However the LOT \wedge connective derived by such natural language structures is not directly encoded by any lexical item, i.e. there is no formula value in D_{Fo} that has the form: $\lambda p.\lambda q.\wedge(p,q)$. The conjunctive formula at the root node of a tree is induced by general computational rules which evaluate the content of the two trees and insert the connective \wedge . So in relevance theoretic terms the conceptual content that is indicated by the LOT connective \wedge is either not contributed by any lexical items at all (e.g. in relatives) or is derived by a combination of lexical actions and computational rules (coordination, juxtaposition). Therefore there is no direct encoding of a LOT coordinate structure in natural language (i.e. there is no node on a DS tree where the connective \wedge is located as formula value with its two arguments decorating other nodes). The reason that things are set up this way in DS is because there is no natural language where there is any direct evidence for a lexical item that operates like the presumed functor which takes propositions one-by-one as its arguments. In what concerns us here there are now two conflicting considerations: Firstly since it has proved extremely hard to provide an account of the semantics of *if-then* sentences for natural language (witness the huge literature) it is far less likely that there is a direct encoding in natural language of the conceptual content represented by implication, \rightarrow , than that represented by \wedge . Therefore the *if as a functor analysis* does not look very promising in the context of DS assumptions. On the other hand, because the conceptual content \wedge is a weaker and much more ubiquitous notion than the content expressed by the connective \rightarrow , whatever this is, it is a legitimate question whether the latter is specifically encoded in, perhaps some, natural languages, especially since the English expression *if p, q* looks suspiciously like the encoding of a functor preceding its two arguments (that could be a case of “grammaticization” since it is not

formulas not trees; in that sense the root of a (global) tree has a certain significance beyond its constituents. Therefore the fact that propositions can be presented in the form of trees is irrelevant for the actual operation of LOT; although such a system could be defined, at present, operations like Modus Ponens are not defined to apply on tree representations. In that respect, the trees are just a necessary intermediary between natural language and LOT, not LOT expressions themselves. On the other hand, the notion of *global tree* captures nicely the concept of a *single inferential unit* that will be exploited later for binding purposes.

absolutely clear that all languages morphologically mark conditional structures see Haiman 1986). Moreover, the functor analysis admittedly would provide a straightforward and therefore theoretically pleasing (*surface-compositional*) view of natural language if the syntax/semantics asymmetries that motivate unprecedented structural analyses like the one in (40) could be overcome. Since DS places a large part of the burden of deriving the structured semantic representation onto the processing mechanisms it could be argued that we could maintain a simple functor-argument analysis for the semantic representation of conditional sentences without having to include extraneous representations or operations.

We now need therefore to question whether there is *linguistic* evidence for or against the direct encoding of the LOT connective \rightarrow as a functor: Even if the truth-functional interpretation for \rightarrow is not necessarily preserved, is there syntactic evidence that the natural language construction *if p, q* derives directly a $P \rightarrow Q$ LOT-sentence by means of function application? Or is it the case that, like in the DS derivation of \wedge -LOT-sentences with relatives, we have some derivative encoding of $P \rightarrow Q$? And would the insistence on maintaining the functional analysis lead to an overwhelming gap between natural language structure and conceptual structure that has to be bridged by postulating unwieldy mechanisms and introducing new primitives? There are two types of consideration here. Is an *if*-clause-main clause structure the only way to encode the \rightarrow LOT connective? If it is not, then it is quite possible that the intuitive truth conditions of a conditional are not necessarily directly encoded by any natural language lexical item. In the same way as with the DS analysis of conjunction and juxtaposition it could be the case that derivation of \rightarrow representations is the result of general computational actions or free pragmatic inference or even a combination of the two. The other type of evidence is distributional/syntactic. As we said we need our representations in combination with the processing rules to account for the linguistic phenomena that need to be explained because we do not have any other explanatory mechanisms available. We will start with the latter.

3.a.1. Syntactic/Distributional evidence against the functor analysis

The traditional notion of subordination or adjuncthood reflects the distributional properties of some clauses as not being able to appear in isolation (see e.g. Bloomfield 1948 , cf. Haiman 1983: 923). From this point of view *if*-clauses seem to pattern with other embedded clauses and would be characterised equally as subordinated:

- (43) *That John left
- (44) *If John comes

However, this is a theory-dependent criterion. It embodies the stance that the grammar deals with sorting out grammatical *sentences* rather than giving an account of how *utterances* are processed. In terms of a theory like DS, which accounts for the mechanisms by which utterances lead to the construction of meaning representations, the strings in (43)-(44) above cannot be characterised as *ungrammatical* since they could occur provided that the appropriate context is supplied. For example they could be answers to the following questions:

- (45) What did John say?
- (46) Under what circumstances are you thinking of leaving?

Furthermore this traditional criterion does not distinguish between subordination and coordination since, from that point of view, a second conjunct cannot appear in isolation either (unless the appropriate context is provided):

- (47) *And John came.

In terms of DS, we can capture the difference in distribution that might be felt as underlying the above judgements in terms of the notion of *well-formedness in context* developed in Cann et al (2005: ch. 9). This will give a characterisation of the above strings (43)-(44) and (47) as essentially context-dependent. However this cannot be taken as a criterion for subordination since main clauses containing pronominals and other anaphoric devices would also have to be classified in the same way. Therefore the traditional

distributional criterion of subordination is not of much use in the present context. On the other hand, the facts noted above in (5)-(6) regarding the positional flexibility of the *if*-clause militate against any simple-minded order preserving analysis in terms of functor-argument relations, therefore unless we invoke some operation of movement or its equivalents strings like *if p q* are not necessarily evidence for a functor followed by its arguments. From a distributional perspective, the grammatical properties of a sentential string remain the same whether it includes an *if*-clause or not. There are no verbs for example that require their propositional object to be an *if...then..* sentence⁶⁰. It is in this sense that *if*-clauses have been characterised as *adjuncts*, that is, they can be omitted or added freely without loss of grammaticality or selection properties. This is partly reflected of course in the analysis in (42) above since the type of the complex proposition is the same as the types of the two arguments. And presumably the functor encoded by *if* combined with the first clause (the antecedent) would not be expected to result in a stand-alone structure since it would still require another argument, whether provided by linguistic input or by context. On the other hand, if this is the case, then there is no structural reason reflected in the analysis above justifying why the two clausal arguments of the function \rightarrow should behave any differently. In fact claiming that the *if*-clause provides the functor whereas the content of the consequent serves as the argument gives incorrect and unintuitive results. As we saw above, there are asymmetries in the syntactic behaviour of the main and the *if*-clause. For instance *if*-clauses do not allow “extraction” whereas the main clause can be extracted from:

- (48) Who if John gets upset will you punish __?
- (49) *Who if John punished __ will you get upset?
- (50) *Who if John punished __ you will get upset?

Extraction from clausal arguments is generally allowed but if the extracted elements in (48)-(50) were related to their base position by only steps of dominance relations there would be no explanation for the grammatical

⁶⁰ I am assuming here that indirect questions introduced by *if* are a distinct category. This is by no means obvious.

asymmetry. However, like relative clauses and unlike clausal arguments, *if*-clauses are strong-islands. Therefore the propositional content they contribute cannot be possibly analysed in DS as belonging to the same proposition as the content derived from the consequent unless radical revisions to the framework were made (similar considerations motivate the Cormack & Smith 2005 analysis).

Another related indication of the subordinated status of *if*-clauses is that they cannot bear independent speech act indicators, that is, the verb form inside the *if*-clause cannot be in Imperative mood or in question form:

- (51) *If come to the party it will be fun
- (52) *It will be fun if come to the party
- (53) *If are you busy you will come to the party?

In this respect *if*-clauses resemble subordinated clauses and relatives which are also unable to have independent speech act indicators:

- (54) *John asked that did Mary come home?
- (55) *John said that come home
- (56) *John, who did you like, came home

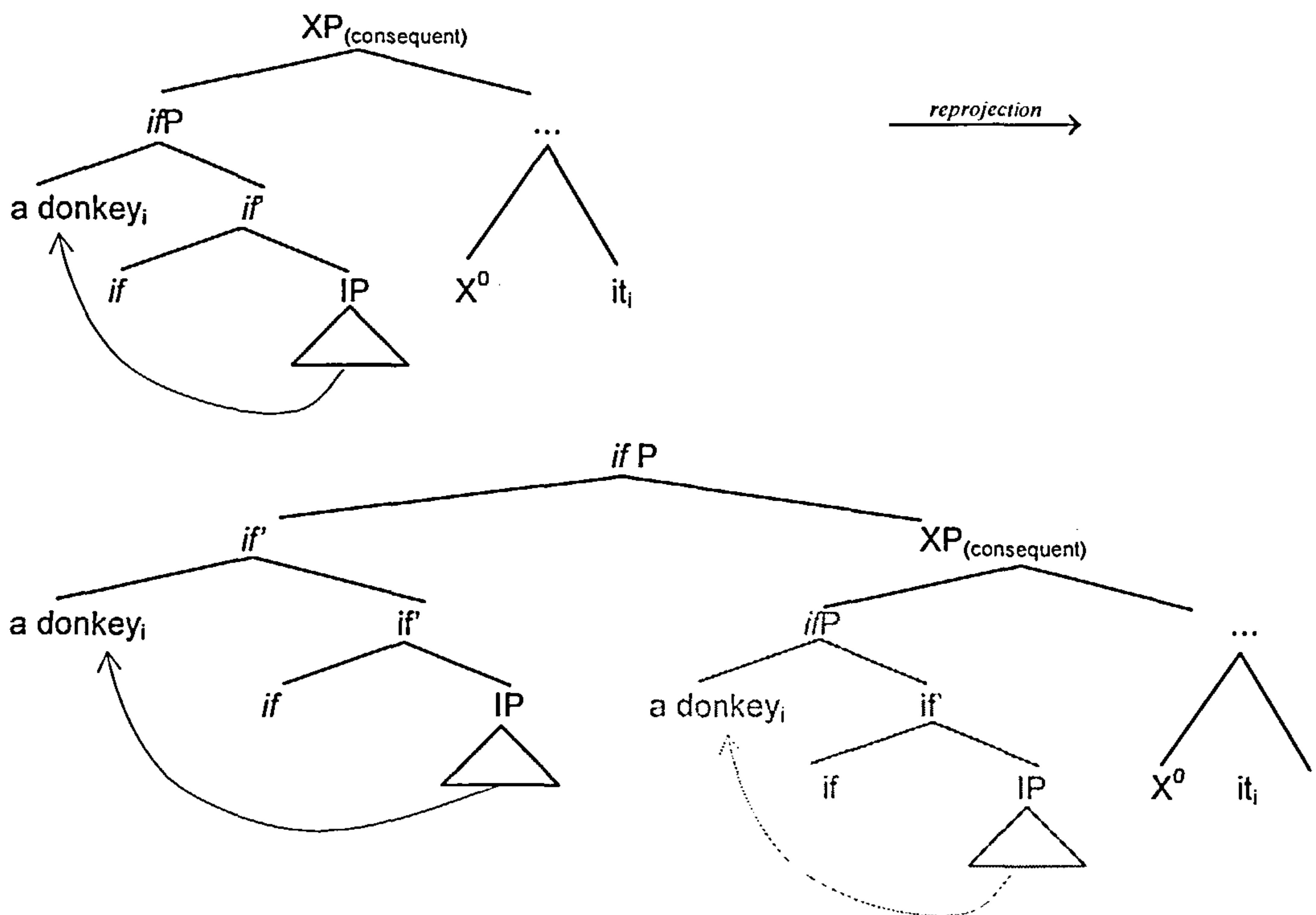
On the other hand, there are conditional assertions, questions and commands and these are indicated by the grammatical form of the consequent which is what has motivated the traditional claim that the consequent provides the primary structure, not just the argument to another function:

- (57) If you are not busy come to the party.
- (58) If you are not busy are you coming to the party?
- (59) Will you come to the party if you are busy?

This evidence points to the conclusion that the type of analysis illustrated by (42) does not directly account for the syntactic asymmetries between antecedent and consequent in conditional sentences. There are ways to overcome these difficulties but it involves a lot of processing to derive the syntax-semantics mismatch. Boeckx (2003) attempts a solution: Current semantic/discourse analyses of conditionals define a notion of subordination between antecedent and consequent but the subordination relation is the

reverse of what the syntactic evidence indicates (see e.g. Kamp & Reyle 1993). In these analyses, the content of the antecedent subordinates the content of the consequent for purposes of interpretation and anaphora resolution. To make the semantic account compatible with the syntactic evidence Boeckx (2003) employs the mechanism of *reprojection* (Hornstein & Uriagereka 2002) to reverse the adjunct (*if*-clause)-main clause (consequent) relation on the way from surface syntactic analysis to LF so that an quantified antecedent can c-command a donkey pronoun:

(60) if John owns a donkey_i he beats it_i



The main motivation for such a destructive operation is to account for the binding of donkey pronouns like *it* above which resist the standard syntactic analysis in terms of constituency in combination with the assumption that bound anaphora requires c-command. The fact that the functor analysis necessitates this type of operations militates against it (as is also the case for the approach shown in (40) above). We are going to see in a later chapter whether a distinct structural analysis of conditionals in combination with the

standard DS analysis of anaphora can account for the same phenomenon with less radical innovations in the grammar.

The issue of anaphora, involving partly structural and partly semantic considerations brings us to the interpretational issues regarding the choice of analysis. We will now turn to the question as to whether it is possible to derive a conditional interpretation from natural language input that does not have the form of an *if p, (then) q* string. If this is possible we then need to decide whether the lexical input provided by *if* is really encodes content which directly derives LOT sentences involving the \rightarrow connective. Or whether, in parallel with coordinate/juxtaposed structures and the connective \wedge , the conditional meaning is derived by other means.

3.a.2. Interpretational evidence against the functor analysis

One type of evidence that points to the conclusion that natural languages can express the LOT connective \rightarrow in ways other than the form *if p, (then) q* is the claimed equivalence in meaning between conditionals and certain coordinate structures (see e.g. Culicover & Jackendoff 1997, Dancygier & Sweetser 2005: ch. 9). The propositional content taken to be explicitly encoded by a conditional construction can be expressed in natural language by the simple coordination of two clauses:

- (61) You come to me in two years' time *and* I'll tell you if I was right (NS.WB.166 cited in Dancygier & Sweetser, *ibid*: 238)
- (62) You pay us a trillion bucks *and* we'll take you to a Hoosegow. Then you can bargain with them. (NS.SC.50, *ibid*)
- (63) Kiss my dog and you'll get fleas. (= If you kiss my dog you will get fleas)
- (64) Komm (du) bloß einen Schritt nährer, und ich schieße German (from Han 2000)
 come (you) only one step closer and I shoot
 Come one step closer and I'll shoot
- (65) Ela pio konda ke tha se pirovoliso Modern Greek
 Come more close and will you shoot
 Come closer and I'll shoot you

As these structures are reportedly widely attested cross-linguistically (see, e.g. Han 2000) one cannot dismiss them as accidental/arbitrary idiosyncrasies of English. Therefore there are two options for analysing what is going on here: (a) we could conclude that the conditional meaning is not

encoded but derived by inference (cf. Clark 1993), or, (b) it is encoded and it is a property of UG to generate such meaning-form correspondences. If what is grammatically encoded in these structures is \wedge -conjunction then what is ultimately derived, i.e. the conditional interpretation, is a weakening of the information that had been encoded. Therefore the only solution for a monotonic grammatical framework like DS is either to postulate an ambiguity of the conjunction *and* (cf. Culicover & Jackendoff 1997), sometimes \wedge sometimes \rightarrow , or to leave it to pragmatic processes to derive the conditional interpretation in the above. The latter need not upset the operation of the grammatical formalism since the non-monotonic nature of the phenomenon points directly to the involvement of inference processes (see e.g. Carston 1998 regarding *concept loosening*). Since ideally we would like to opt for ambiguity only as a last resort we should consider to leave it to pragmatic processes to derive the conditional meaning in (61)-(65) above⁶¹. Such an account will also explain why the construction remains “iconic” in that the positional flexibility enjoyed by *if*-clauses is not available here. In that case, it can be claimed that a structure with an *if*-clause is nothing but a grammaticised encoding of the inferentially derived meaning seen in (61)-(65), an encoding which being well established allows for positional flexibility, and tense/mood patterns not allowed with *and*-conditionals. Taking *and* as encoding a functor taking two propositional arguments (Cormack & Smith 2005)⁶², the analysis of *if* as encoding a function which takes two type *t* arguments is then the obvious choice since the conditional structure would be nothing more than a crystallisation of an enriched meaning available to coordinate structures as well. However, there is evidence that the conceptual content encoded in *if*-structures is a conceptual primitive (Wierzbicka 1997)

⁶¹ There is one more option within the context of DS assumptions: as suggested by Dancygier & Sweetser (2005) inferential patterns can become encoded over time and *and*-conditional constructions can be seen in those terms. DS offers a formal reconstruction of this intuition in terms of *routinisation* (see Cann et. al. 2005: Ch. 9). We can therefore consider an analysis in terms of *routinisation* which will explain both the “subordination” properties of such constructions and their basis on inference patterns. This is an issue for further research in the present context.

⁶² In fact they argue that the lexical item *and* is a “marker” not the actual operator itself which is implicit but we simplify here.

and therefore there is no need to argue that it is derivative. On the other hand, as we saw, such an analysis does not provide a straightforward basis to derive the idiosyncratic properties of *if*-clauses which seem to parallel the behaviour of relatives and contrast with that of coordinate structures. The challenge now that these considerations present for the current account is to capture the syntactic facts that are adduced in favour of *if*-clauses being adverbial subordinate clauses without postulating ad hoc syntactic configurations and mechanisms. If there are sui generis syntactic properties that characterise *if*-clauses and other adjuncts the DS assumptions require them to be accounted for either in terms of encoded lexical instructions or as reflecting the dynamics of processing. We will now turn to examine more evidence that support a subordinating analysis of *if*-clauses as well as the syntactic properties that the DS analysis has to account for.

3.b. Subordination types

As we said above there are only two options in DS for “subordinating” the content of one clause to that of another: either one is the argument of the predicate of the other or there is a LINK relation between the nodes of the two independent trees. We are going to see now what seems to be contradictory diagnostic evidence in that respect in that *if*-clauses present behaviour that bears the characteristics of each type of subordination.

3.b.1. The subordinative properties of *if*-clauses:

Besides the structural properties of conditional sentences that were presented above there are a few more phenomena that any syntactic analysis of conditionals has to account for. The behaviour of *if*-clauses parallels the behaviour of another type of clause, relative clauses, pointing to the conclusion that a similar analysis should be assigned to them (i.e. an analysis in terms of LINKed structures). However the freedom of movement for the *if*-clause shown above in (5)-(7) and elsewhere indicates that there is a difference: relative clauses in English can be dislocated as long as they follow the argument to which they attach (besides cases of extraposition) and under

these circumstances they are never dislocated out of “islands” exactly because arguments cannot violate island restrictions. Therefore if we are to give a parallel analysis to all such clauses there has to be an argument inside the tree representation constructed from the consequent to which the content of the *if*-clause attaches by the LINK relation. Moreover, the presence of *then* in the consequent and the obligatory preverbal position of the *if*-clause in those cases, as well as data from other languages, points to a parallel, noted by many researchers previously, between left dislocated *if*-clauses and *correlatives*. Let's now see the syntactic behaviour that we have to account for.

First of all, besides positional freedom for the *if*-clause, there is no strict adjacency requirement between antecedent and consequent. The consequent corresponding to a clause-initial antecedent might be embedded as can be seen in the cases below:

(66) [If John is late again] Mary believes that Bill will fire him =

- a. Mary believes that *if John is late again* Bill will fire him
- or
- b. *If John is late again* then it is the case that Mary has the belief that Bill will fire him.

However, the distance between antecedent and consequent is not arbitrary. Their separation respects what in the linguistic literature are sometimes called *island restrictions* (Iatridou 1991). This means that, for example, the antecedent of a conditional cannot be construed as originating inside a relative clause or the complement of a noun (*Complex NP-constraint*, Ross 1967):

- (67) Mary called the man who will be hired *if John leaves*. \Rightarrow
- (68) **If John leaves* Mary called the man who will be hired.
- (69) [If Bill fails]_i John saw the teacher who will be fired _j
- (70) \neq John saw the teacher who will be fired if Bill fails
- (71) Mary believed the claim that Bill will leave *if John stays*. \Rightarrow
- (72) **If John stays* Mary believed the claim that Bill will leave.

This seems to imply that antecedent and consequent stand in some kind of local relation that has to be expressed by the formalism. Another property of

such structures that has to be explained is the fact that, like in relative clauses, extraction is not allowed from inside an *if*-clause, i.e., *if*-clauses are themselves *islands*:

- (73) John saw the man who shot Mary \Rightarrow
- (74) *Who did John see the man who shot?
- (75) John will fire Mary [if she calls John]. \Rightarrow
- (76) *Who will John fire Mary if she calls _ ?
- (77) [If John sees Mary] he will kiss her. \Rightarrow
- (78) *Who [if John sees _] will he kiss her?

As we said earlier, *if*-clauses lack independent “illocutionary force” markers and seem to be included in the speech act performed by use of the main clause. This is similar to what is found with relative clauses:

- (79) *John, who do I like, left
- (80) *The table that (you) move is not heavy

The presence in the main clause of *then* or its analogue in other languages is reminiscent of the correlativisation strategy that many languages use in order to form relative clauses (von Stechow 1994; see the Warlpiri and Hindi data in Chapter 3). This type of structure has to be accounted for too:

- (81) If he is sick *then* he stays at home
- (82) Wenn er krank ist, *dann* bleibt er zu Hause *German*
(from Koenig & van der Auwera 1988)

The correlativisation facts however when taken in their cross-linguistic perspective point to the possibility that there might be various degrees of subordination that have to be captured by the analysis (as argued by Koenig & van der Auwera *ibid*). In V2 languages like German and Dutch an indication of embedding is that the verb occurs clause-finally. For example, in general, clauses that appear as the argument of another verb have their own verb in final position (there are exceptions concerning some “bridge” verbs and some other constructions see, e.g. Koenig & van Auwera *ibid*, Heycock 2002). In contrast, in unembedded clauses the verb occurs as the second constituent, following a left-dislocated constituent or the subject (V2). *If*-clauses pattern invariably with subordinated clauses in that they do not allow for V2. On the

other hand, the fact that a conditional relation might be derived inferentially between two clauses does not affect verb position. In (83) below there can be an inferentially derived conditional meaning; however the word order in the two clauses is not affected:

- (83) Du liebst mich, und ich bin glücklich *German (from Haiman 1986)*
 you love me and I am happy
 (84) Wenn du mich liebst, (dann) bin ich glücklich
 if you love me (then) am I happy
 if you love me I am happy

This shows that the presence of an element like *if* in a clause has significance not only for its semantic/inferential properties but also for its overall syntax. Distinct syntax however does not mean that the meaning encoded by it cannot be derived inferentially. In addition certain types of conditional can have a *paratactic* form in that the lack of a complementiser like *if* or its analogues is offset by verb-initial syntax:

- (85) if John had seen Mary ...
 (86) Had John seen Mary ...
 (87) Should you wish to go, please let me know
 (88) Wenn Hans kommt dann geht Susanne *German (from Iatridou & Embick 1994)*
 if Hans comes then goes Susan
 if Hans comes, Susan goes
 (89) Kommt Hans dann geht Susanne
 comes Hans then goes Susanne
 if Hans comes, Susan goes
 (90) Wäre Hans gekommen, dann wäre Susanne abgefahren
 Had Hans come, then would-have Susanne left
 Had Hans come, then Susanne would have left

Unlike the paratactic “conditional” in (83) though such structures must be interpreted as conditionals. This shows that even though conditional interpretations can be derived by inferential processes there is also a cross-linguistic tendency for distinctive encoding of such meanings either by a selected lexical item or by a particular syntactic form (see Comrie 1986 and Bhatt & Pancheva 2005: 642-645 for a survey of means for encoding these interpretations).

Regarding the behaviour of *if*-clauses with respect to subordination to the consequent, according to Koenig and van der Auwera (1988), there are three patterns of *if*-clause integration in German and Dutch:

- (a) a clause-initial *if*-clause can be immediately followed by the finite verb; in this case it seems that the *if*-clause can count as the first constituent for V2.
- (b) the *if*-clause is followed by resumptive element like *then* in English with the finite verb following; in this case the *if*-clause would seem to be a more peripheral element than in the previous structure
- (c) the *if*-clause precedes another topical constituent and the finite verb follows; in this case also the *if*-clause does not count as the first element for V2; therefore it could be seen as peripheral again even though there is no overt resumptive element in the main clause.

In present terms this evidence seems to point to the conclusion that even if one pursues an integrational analysis for the content derived by *if*-clauses the possibility of it functioning as a peripheral element has also to be taken into account. This is not an unexpected outcome since, according to the DS analysis of nominal arguments, any argument inside a clause can be related to another peripheral element in the so called Topic structures. We will take up the latter issue in the next chapter. Below we will present an analysis for fully integrated *if*-clauses.

4. A DS analysis of conditionals

4.a. Introduction of the situation argument

In the present analysis of conditionals, following much current work in the formal semantics literature, we will employ an additional argument for propositional representations standing for the situation of evaluation (see Heim 1990, von Stechow 1994, Chierchia 1995 a.o.). Farkas (1997) proposes that for each world w we define an extensional model $M_w = \langle S_w, U_w, V_w \rangle$ where S_w is a set of situations in w , U_w is the set of individuals in w and V_w

assigns values to the constants of the language with respect to the situations in S_w . As suggested in Kratzer (1986) we assume that situations are parts of worlds, each situation part of a unique world. Truth of a logical form (lf) in a world w is determined with respect to truth in a situation in w :

- (91) An lf is true in w with respect to M iff there is a situation $s \in S_w$ such that the lf is true in s with respect to M_w .

For our purposes the situation argument of a predicate will be explicitly represented on the tree and will combine with it by the usual means of function application. Crucially for the present analysis, the situation argument can be a variable, an epsilon term or a tau term. These terms will appear in the scope statement as any other regular argument. Taylor (1985), among others, provides motivation for the view that explicit existential quantification over situations is involved in the logical form of natural language sentences. Simplifying somewhat, the sentence below can be taken as ambiguous between the two logical forms displayed below it:

- (92) Henry gracefully ate all the crisps
 (93) $\forall y. \text{Crisp}'(y) \rightarrow \exists e. \text{Eat}'(\text{Henry}', y, e) \wedge \text{Graceful}'(e)$
 (94) $\exists e. \forall y. \text{Crisp}'(y) \rightarrow \text{Eat}'(\text{Henry}', y, e) \wedge \text{Graceful}'(e)$

In addition Farkas (1997) argues that the situation argument must scopally interact with individual quantificational terms in order to derive the range of interpretations possible for the following:

- (95) If a boy *he likes* comes over, Johnny shows *him* his turtle.

The indefinite in the above according to Farkas can be interpreted as having either wide scope with respect to the situations of evaluation, in which case there is a particular boy being mentioned, or it can have narrow scope in which case for each situation considered there is potentially a different boy involved. The obvious way to deal with these cases in DS is to allow terms representing situations to appear in the scope statement and interact freely with the variables contributed by the nominal terms. As is standard in DS, we assume that indefinites contribute epsilon terms which must necessarily depend on some other term in the current tree. In the case above in order to

derive the wide scope of the epsilon term derived from the indefinite, we need a DS representation in which this term outscopes another term representing the range of situations introduced by the conditional. The term derived from the indefinite will in turn be outscoped by the world of evaluation which must be taken as necessarily the first element in the scope statement. It also appears as the argument of the monadic predicate *World*, decorating the *Ty(t)* node, e.g. *World(w₁)*. Although we will not deal with modality and tense issues in the present work we will assume that the world of evaluation *w* will also eventually appear as a label on the formula decorating the root node of a propositional tree as is standard in DS. This is because we do not expect that there are any scope ambiguities regarding terms and the world of evaluation for each proposition. Being the label, the world of evaluation has necessarily widest scope and acts as a point of reference for the evaluation of all other terms. The Q-Evaluation rule has to be modified now to reflect this view:

(96) **Q-Evaluation Rule:**

$$\frac{\{ \dots \{ \text{Ty}(t), \dots, \text{World}(w[x_1]), \text{Scope}(x_1 < \dots < x_n), \text{Fo}(\varphi[v x_n \psi_n/x_n]) \dots \} \}}{\{ \dots \{ \text{Ty}(t), \dots, \text{World}(w[x_1]), \text{Scope}(x_1 < \dots < x_{n-1}), \dots, \text{Fo}(f_{v x_n \psi[v x_n \psi_n/x_n]}(\varphi)), \dots \} \}}$$

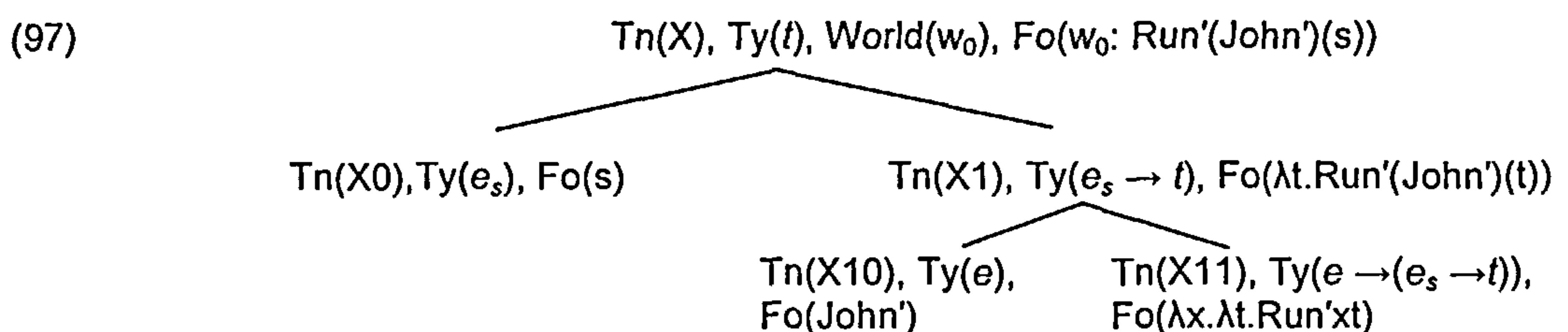
where for *x* occurring free in φ and $w[x_1] =$ a world variable x_1 or $w[x_1] = v_1 x_1 \psi$, the values $f_{v x_n \psi[v x_n \psi_n/x_n]}(\varphi)$, for $v \in \{\epsilon, \tau, Q\}$ and $f_{w[x_1]}(\varphi)$ are defined by:

- (a) $f_{\tau x \psi}(\varphi) = \psi[a/x] \rightarrow \varphi[a/x]$
where $a = \tau x (\psi \rightarrow \varphi)$
- (b) $f_{\epsilon x \psi}(\varphi) = \psi[b/x] \wedge \varphi[b/x]$
where $b = \epsilon x (\psi \wedge \varphi)$
- (c) $f_{Q x \psi}(\varphi) = (\psi[c/x]) (\varphi[c/x])$
where $c = v_Q x ((\psi)(\varphi))$
- (d) $f_{w[x_1]}(\varphi) = w[x_1]: \varphi$

The actual world w_0 is the default world of evaluation. Modals and other intensional operators can be seen to optionally introduce new worlds of evaluation by existentially or universally quantifying over worlds accessible from w_0 . We will now see how these assumptions will be implemented in the DS tree representations.

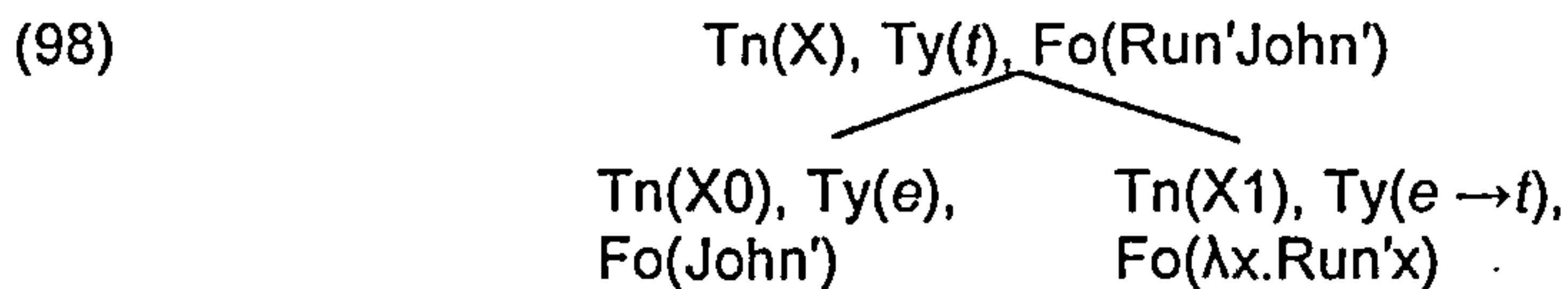
We will add a new type in D_{Ty} in order to allow the situation argument to be processed. We will call this new type $Ty(e_s)$. We assume then that the values in D_{Ty} are sorted with $Ty(e)$ as a general type with subtypes of $Ty(e_s)$ for situations and $Ty(e_i)$ for individuals, $Ty(e_w)$ for worlds etc. However for simplicity of illustration we will continue to notate the type of individuals as $Ty(e)$, i.e. we will omit the subscript when no ambiguity arises. Metavariables can be specified to take values either of the most general type ($Ty(e)$) or the more specific types ($Ty(e_i)$, $Ty(e_s)$ etc.).

There are two ways to introduce the situation argument in the representation. (a) The content assigned to verbs (and predicates in general but we omit discussion of this issue here) comes from the lexicon with an additional situation argument. This argument is the last to combine with the predicate. For instance, the Formula value produced by processing an intransitive verb like *run* will now be $\lambda x.\lambda t.Run'(x)(t)$. The tree resulting from the parsing of a string like *John runs* will now be as follows⁶³:



(b) The second option would be to introduce the situation argument as an optional addition to the representation in case it is needed (as e.g. in the case of a conditional structure). This follows suggestions in Recanati (2004) regarding optional arguments. In the present context Recanati's suggestion can be implemented as follows. We maintain that the encoded content of a simple sentence like "John runs" is given as usual with the following representation (omitting tense):

⁶³ We will omit brackets as much as possible when there is no risk of misunderstanding.



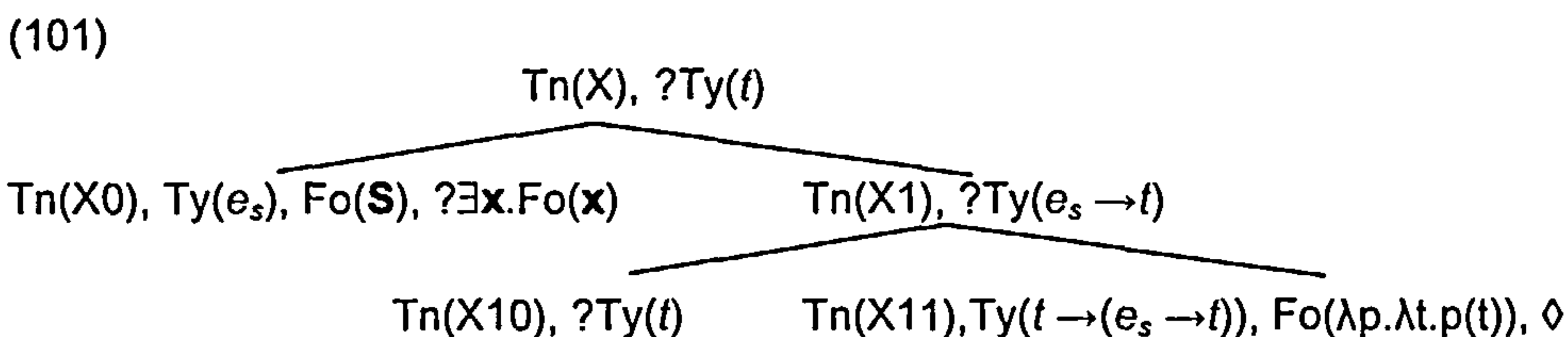
In order to accommodate the presence of a situation argument but without attributing its presence to any linguistic input we can assume a computational rule which introduces the situation argument explicitly to the minimal tree consisting of a requirement for establishing a structure of type t (the *Axiom*):

(99) **Situation Argument Introduction Rule**

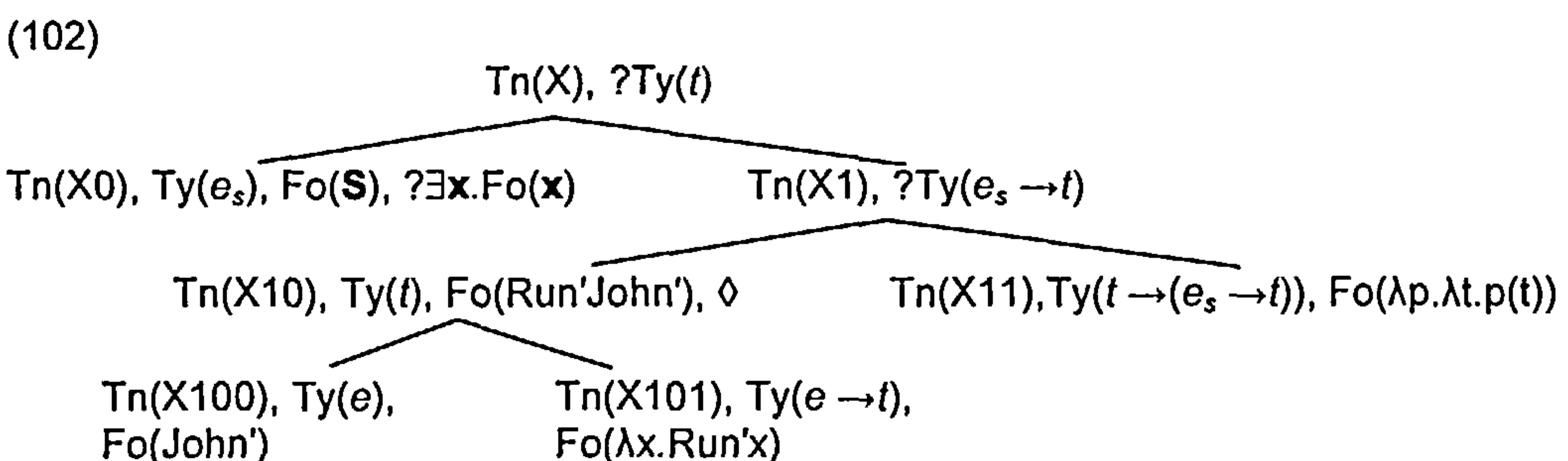
$$\frac{\{ \dots \{ \text{Tn}(n), ?\text{Ty}(t), \dots, \diamond \} \dots \}}{\begin{array}{l} \{ \dots \{ \text{Tn}(n), ?\text{Ty}(t), \dots, \diamond \}, \\ \{ \langle \uparrow_1 \rangle \langle \downarrow_0 \rangle \text{Tn}(n), \text{Ty}(t \rightarrow (e_s \rightarrow t)), \text{Fo}(\lambda p. \lambda t. p(t)) \}, \\ \{ \langle \downarrow_0 \rangle \text{Tn}(n), ?\text{Ty}(e_s \rightarrow t) \}, \\ \{ \langle \uparrow_0 \rangle \langle \downarrow_1 \rangle \langle \downarrow_0 \rangle \text{Tn}(n), \text{Ty}(e_s), \text{Fo}(\mathbf{S}), ?\exists \mathbf{x}. \text{Fo}(\mathbf{x}), \dots \} \end{array}}$$

By application of this rule, the structure in (100) below will be transformed as shown in (101):

(100) $\text{Tn}(n), ?\text{Ty}(t), \diamond \xrightarrow{\text{Situation Argument Introduction}}$

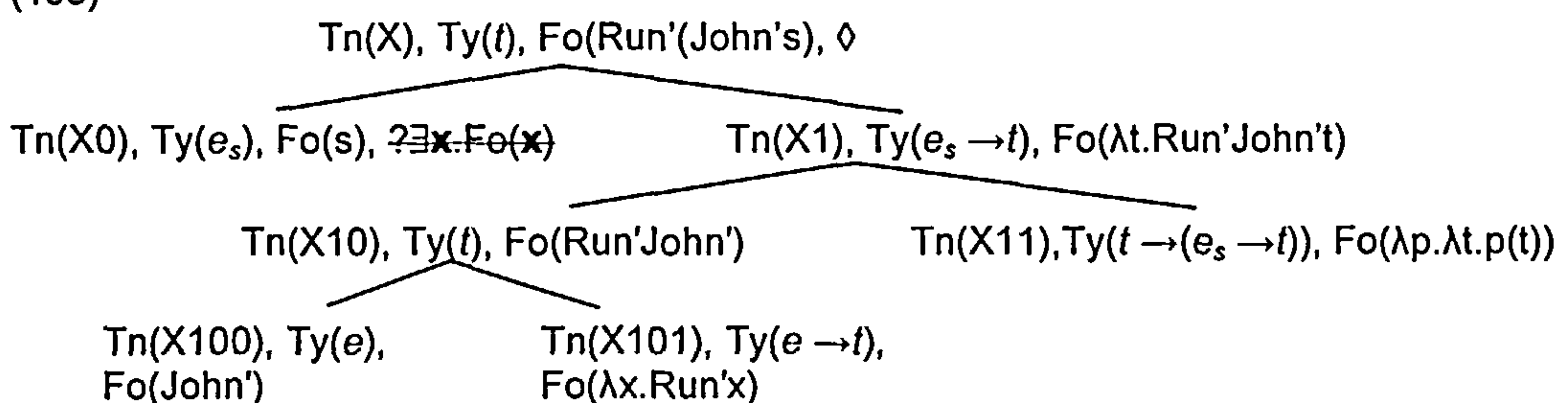


Unless a specification of the situation argument is given by linguistic input (e.g. by means of an *if*-clause sentence initially), the usual rules of parsing will construct the lower propositional tree and the pointer will end up at the $\text{Ty}(t)$ node:



From here the usual rules will also construct the $Ty(e_s \rightarrow t)$ node and move the pointer to the situation node bearing the metavariable. At this point a value for this argument must be provided from context in order for the requirement to be satisfied (it is shown as a free variable below but an epsilon or tau term can also be substituted if available). Once this is achieved the entire structure can be completed by the usual means:

(103)



Since all computational rules are optional the above method constitutes an implementation of the idea that the situation argument is an optional constituent of the proposition expressed, not explicitly encoded in the linguistic input. Other optional constituents can be introduced in a similar way. Although we believe that this method is probably the correct one, for simplicity of illustration in what follows we will use the previous method, option (a), according to which verbs come from the lexicon equipped with a situation argument. We will now illustrate this method more extensively.

In order for the situation argument to be processed by the usual DS processing apparatus, the rules of Introduction and Prediction will be employed to provide for a further $?Ty(e)$ position. Introduction and Prediction starting from the usual $?Ty(t)$ axiom induce two additional nodes: a node with a requirement for $Ty(e_s)$ and its sister $?Ty(e_s \rightarrow t)$. (the scope statement includes the world of evaluation which we have assumed to be w_0 , the actual world as a default (see Papafragou (1996: 186-187), 2000 for justification in the context of a pragmatic theory):

(104)

$$Tn(X), ?Ty(t), World(w_0), Scope(w_0 < \mathbf{S}), ?\exists x.Scope(w_0 < \mathbf{x}), \diamond$$

Introduction and Prediction \Rightarrow

$$(105) \quad \text{Tn}(X), ?\text{Ty}(t), \text{World}(w_0), \text{Scope}(w_0 < \mathbf{S}), ?\exists \mathbf{x}.\text{Scope}(w_0 < \mathbf{x})$$

$$\quad \quad \quad \text{Tn}(X_0), ?\text{Ty}(e_s), \diamond \quad \quad \quad \text{Tn}(X_1), ?\text{Ty}(e_s \rightarrow t)$$

The situation argument will always be initially introduced as a metavariable \mathbf{S}_i , \mathbf{S}_j , \mathbf{S}_k etc. since it is possible to supply a value for it from the context (as a instance of *saturation*). Any quantificational terms introduced subsequently will also be able to depend on this metavariable. In the tree above, with the pointer at the type e_s node the metavariable will be inserted by a computational rule⁶⁴:

(106) **Situation Metavariable Insertion Rule**

$$\frac{\{...\{\text{Tn}(n), ?\text{Ty}(t), ...\}, \{<\uparrow_0>\text{Tn}(n), ?\text{Ty}(e_s), \diamond\}, \{<\uparrow_1>\text{Tn}(n), ?\text{Ty}(e_s \rightarrow t)\} \} \dots\}}{\{..\{\text{Tn}(n), ?\text{Ty}(t), \dots, \diamond\}, \{<\uparrow_0>\text{Tn}(n), \text{Ty}(e_s), \text{Fo}(\mathbf{S}), ?\text{Sc}(\mathbf{S}), ?\exists \mathbf{x}.\text{Fo}(\mathbf{x})\}, \{<\uparrow_1>\text{Tn}(n), ?\text{Ty}(e_s \rightarrow t)\}\}...\}}$$

A requirement for the term substituting for the metavariable to participate in some statement is also inserted ($?Sc(\mathbf{S})$). We will now slightly modify the definition of the monadic predicate Sc in order to make it compatible with the presence of the situation argument which might be a variable, an epsilon, tau or other quantificational term:

$$(107) \quad \text{Sc}(v_{[x]}) =_{df} \\ [v_{[x]} = q, \mathbf{x}, \phi \mathbf{x} \text{ where } q = \epsilon/\tau/Q^{65} \vee v_{[x]} = \mathbf{x}] \wedge \\ <\uparrow_*> (\text{Ty}(t) \wedge \exists \mathbf{y} [\text{Scope}(\mathbf{x} < \mathbf{y}) \vee \text{Scope}(\mathbf{y} < \mathbf{x})])$$

In the new definition the predicate Sc takes as its argument a term (e.g. epsilon or tau term) or a variable and it is satisfied if the variable included in that term participates in a scope statement. We also need a scope action for situation arguments:

⁶⁴ Note that Anticipation can move the pointer downwards if the situation argument is to be developed immediately afterwards.

⁶⁵ Q stands for any other quantificational binder like those contributed by expressions like *most*, *few* etc. (see Kempson et al. 2001)

(108) **Scope action for situation arguments:**

IF $\{ Ty(e_s), ?Sc(v_{[x]}) \}$

THEN $gofirst, (?Ty(t));$

$put(Scope(U < x),$
 $? \exists y (DOM(y) \wedge Scope(y < x) \wedge \forall r (Scope(y < r) \rightarrow Scope(x < r))))$

ELSE $abort$

We also need to modify the definition of DOM to take into account the variables inside situation arguments and the world argument:

(109) $Tn \models_M DOM(a)^{66} \Leftrightarrow$
 $Tn \models_M ?Ty(t) \wedge$
 $[(\downarrow \downarrow [Ty(e) \wedge \langle \downarrow_0 \rangle \langle \downarrow_0 \rangle Fo(a)]) \vee World(v_{[a]}) \vee \langle \downarrow_0 \rangle Fo(v_{[a]})]$
 $where v_{[a]} = (q, a, \phi a \text{ where } q = \epsilon/\tau/Q^{67}) \vee (v_{[a]} = a)$

According to the rule in (106) after insertion of the metavariable on the situation node, the pointer is moved to the root. Suppose that the value for the metavariable **S** can be given by an accessible epsilon term in the context: ϵ, s, ps , for p some salient (potentially complex) proposition. Then the metavariable can be substituted immediately by movement of the pointer to the type e_s node by Anticipation, the rule that moves the pointer from mother to daughter if there is an outstanding requirement. The scope action rule can also apply. This will satisfy the requirements so that Completion can move the pointer back to the root:

(110)

$$\frac{Tn(X), ?Ty(t), Scope(w_0 < s), ? \exists x. Scope(w_0 < x), ? \exists y (DOM(y) \wedge Scope(y < x) \wedge \forall r (Scope(y < r) \rightarrow Scope(x < r))), \diamond}{\begin{array}{cc} Tn(X0), ?Ty(e_s) & Tn(X1), ?Ty(e_s \rightarrow t) \\ Ty(e_s), Fo(\epsilon, s, ps), ? \exists x. Fo(x), ?Sc(\epsilon, s, ps) & \end{array}}$$

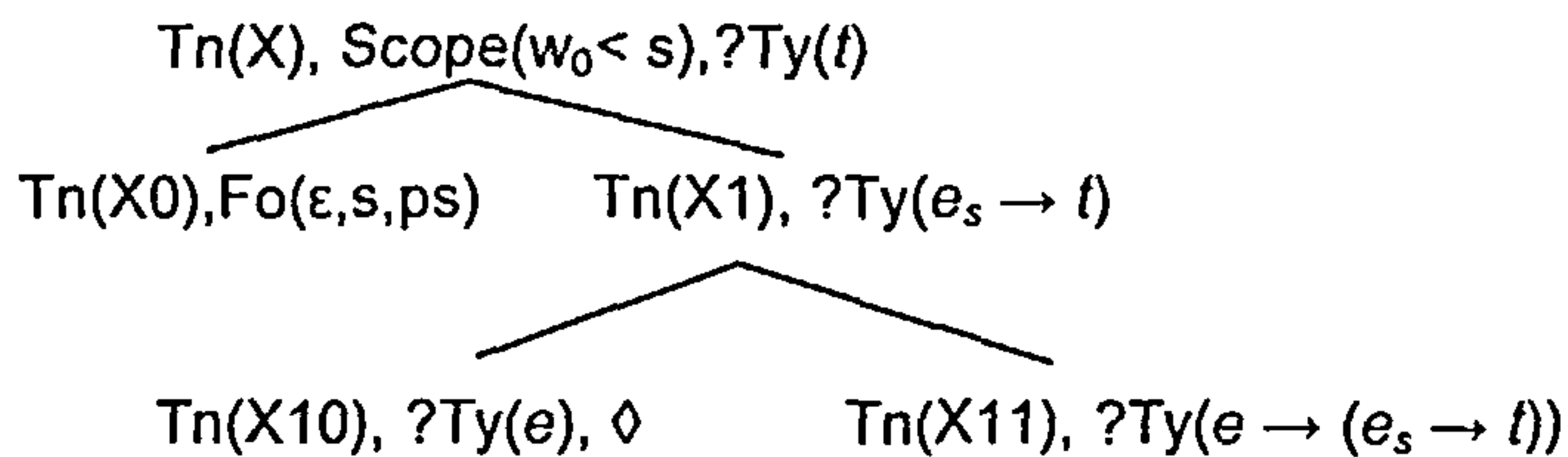
However if there is no appropriate value available for the metavariable at the present moment the underspecified value and requirements can be left to

⁶⁶ In Kempson et al (2001) where the situation argument is treated as a label there is a slightly different definition of the predicate DOM.

⁶⁷ Q stands for any other quantificational binder like those contributed by expressions like *most*, *few* etc. (see Kempson et al. 2001)

await resolution until the latter stages of the parse. In either case, the rest of the parsing rules remain as usual. The $?Ty(e_s \rightarrow t)$ node (which is equivalent to the $?Ty(t)$ node in the standard presentations of DS) can now be expanded with Introduction and Prediction to accommodate the subject and the predicate:

(111) *Introduction and Prediction* \Rightarrow



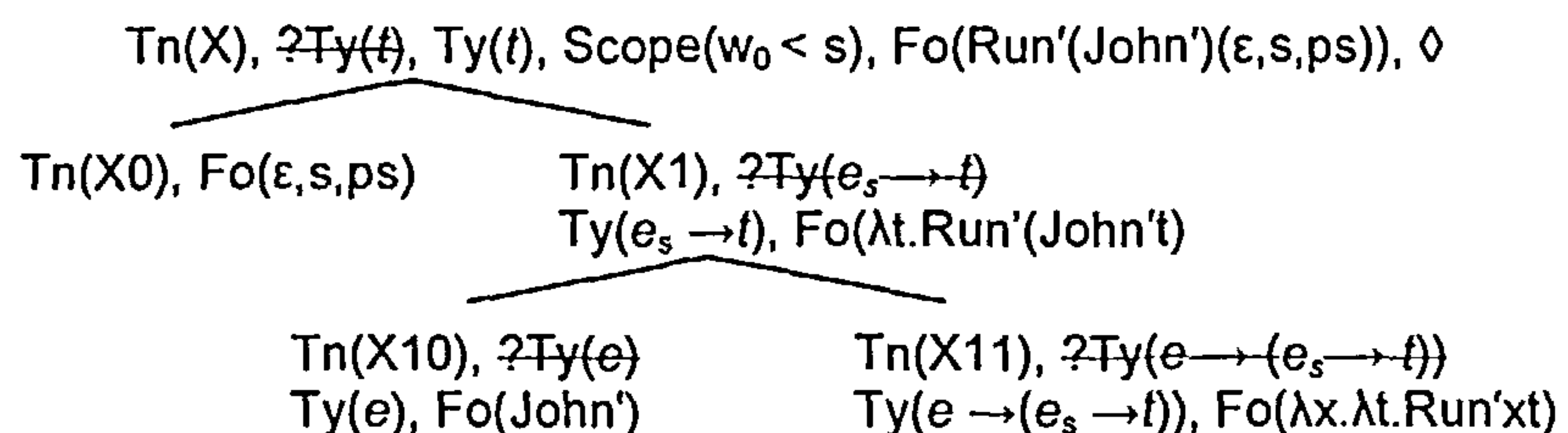
The lexical input provided by *John* can now be processed and this will decorate the type e node. Completion and Anticipation move the pointer to the predicate node where the verb can be parsed. The modified lexical entry for an intransitive verb like *run* is shown below (tense and mood will not be discussed here):

(112) ***run***

IF $?Ty(e \rightarrow (e_s \rightarrow t)), \diamond$
THEN $put(Fo(\lambda x. \lambda s. Run'(x)(s)), Ty(e \rightarrow (e_s \rightarrow t)))$
ELSE *abort*

The transformation of the tree is now as follows after all the usual rules have applied:

(113)



By means of the *Q-Evaluation Rule* the formula on the root node will be converted to: $w_0: p(a) \wedge \text{Run}'(\text{John}')(a)$ where $a = \varepsilon, s, p(s) \wedge \text{Run}'(\text{John}')(s)$.

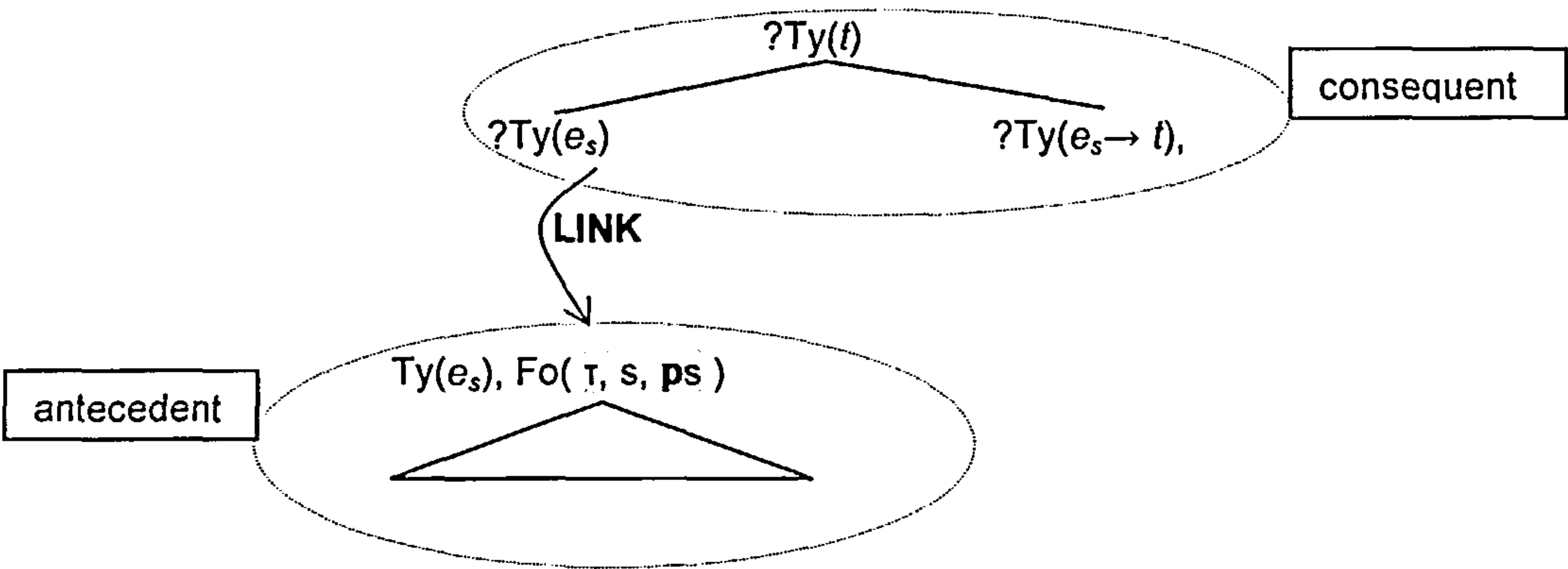
We now have most of what is needed to allow the processing of conditional sentences. Let's see what more needs to be added.

4.b. Conditionals

4.b.1. Logical form

Under the present analysis sentences containing *if*-clauses will be assumed to give rise to two LINKed trees: processing of the main clause, the consequent, results in one tree, let's call it the *main tree* from now on, while processing of the antecedent results in another. The latter appears connected to the situation node of the main tree by the LINK relation. The establishment of this relation will also effect a unification of values between two nodes of the joined trees in the following way: the final result of processing the antecedent of a conditional will produce a tau term (τ -term) as the root of that tree (highlighted in (114) below)⁶⁸:

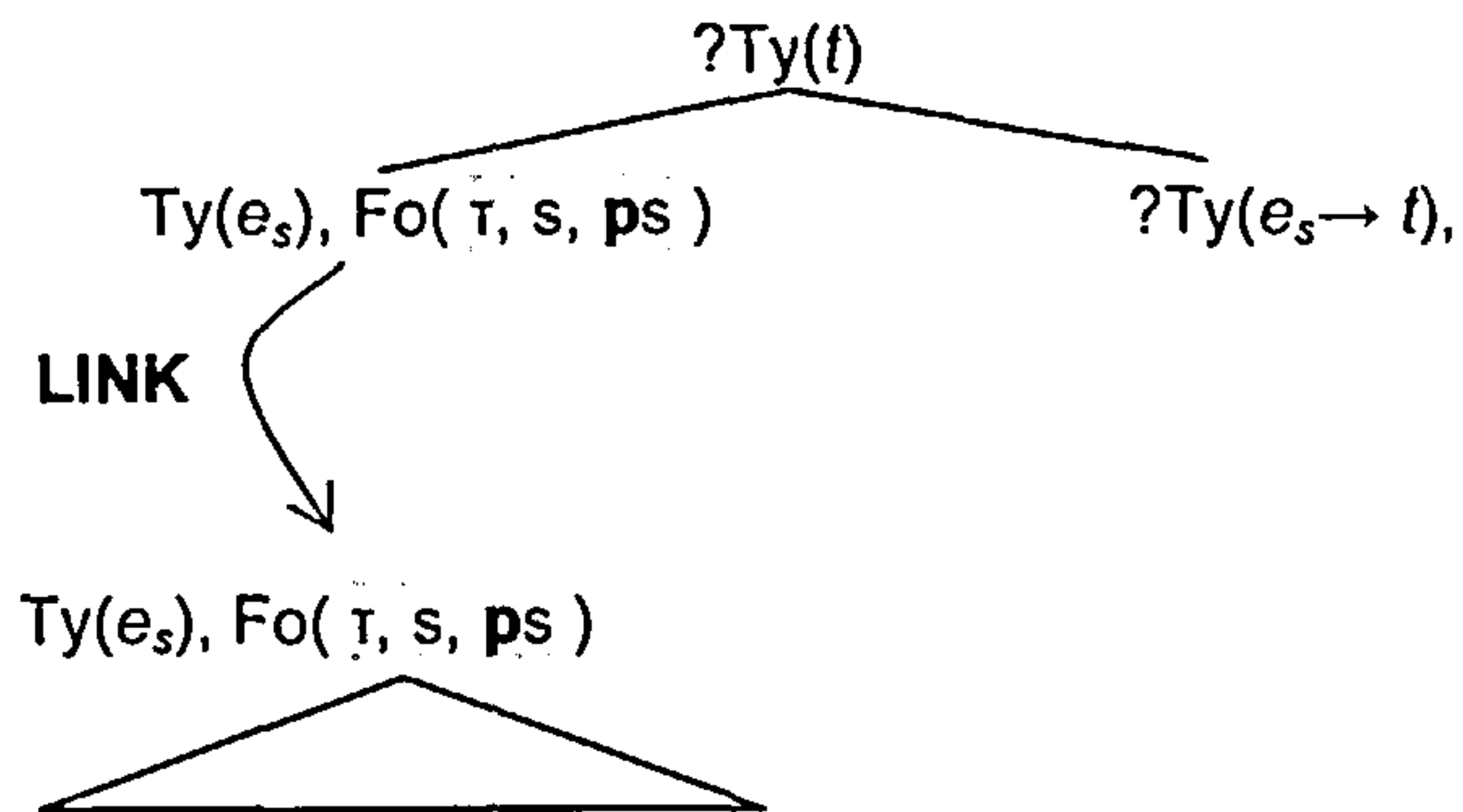
(114) The tree derived by processing *if p* from the string *if p, q*:



This term once derived will be copied in the main tree in order to serve as the Formula value of its situation node:

⁶⁸ We omit reference to the world of evaluation when it is not relevant to the discussion from now on. We also omit the scope statements.

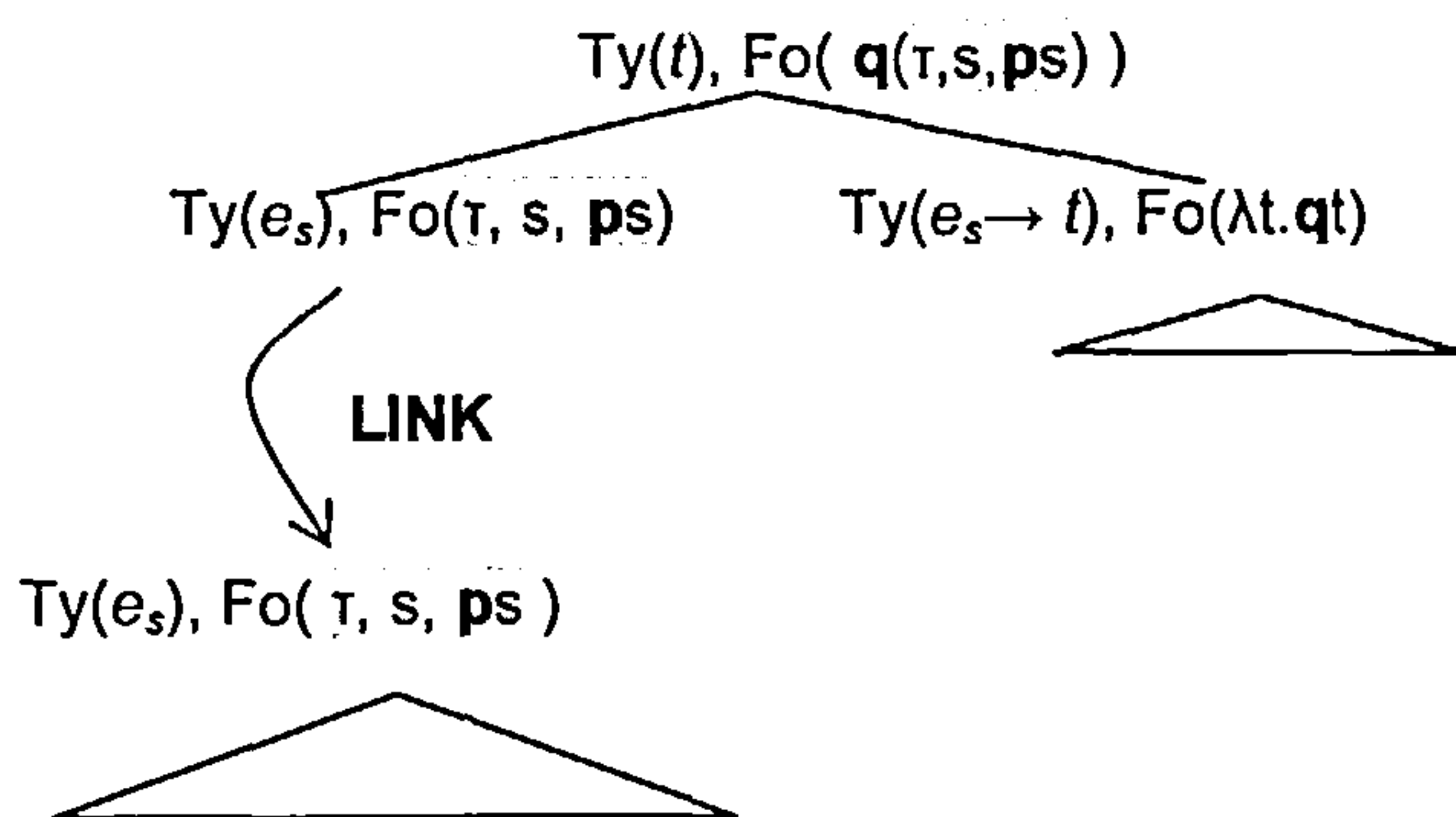
(115)



The newly introduced τ -term in the main tree, being an ordinary argument of the predicate, will be incorporated in the proposition derived at the root through the usual function-application process:

(116)

The global tree derived by processing if P, Q:



Since the shared term is a quantificational τ -term, it will contribute to the Scope Statement of the main tree. The DS rules for processing quantification structures will apply at the end of the parse and yield a propositional structure at the root node:

(117)

Initial Formula derived by parsing if p, q: $q(\tau, s, ps)$
Formula that results after application of Q-Evaluation Rule:
 $p(a) \rightarrow q(a)$ where $a = \tau, s, (ps \rightarrow qs)$

We thus derive a proposition where the content of the consequent (q , above) is construed as a property of situations. What is asserted is that this property q is true of all the situations that satisfy the description p provided by the

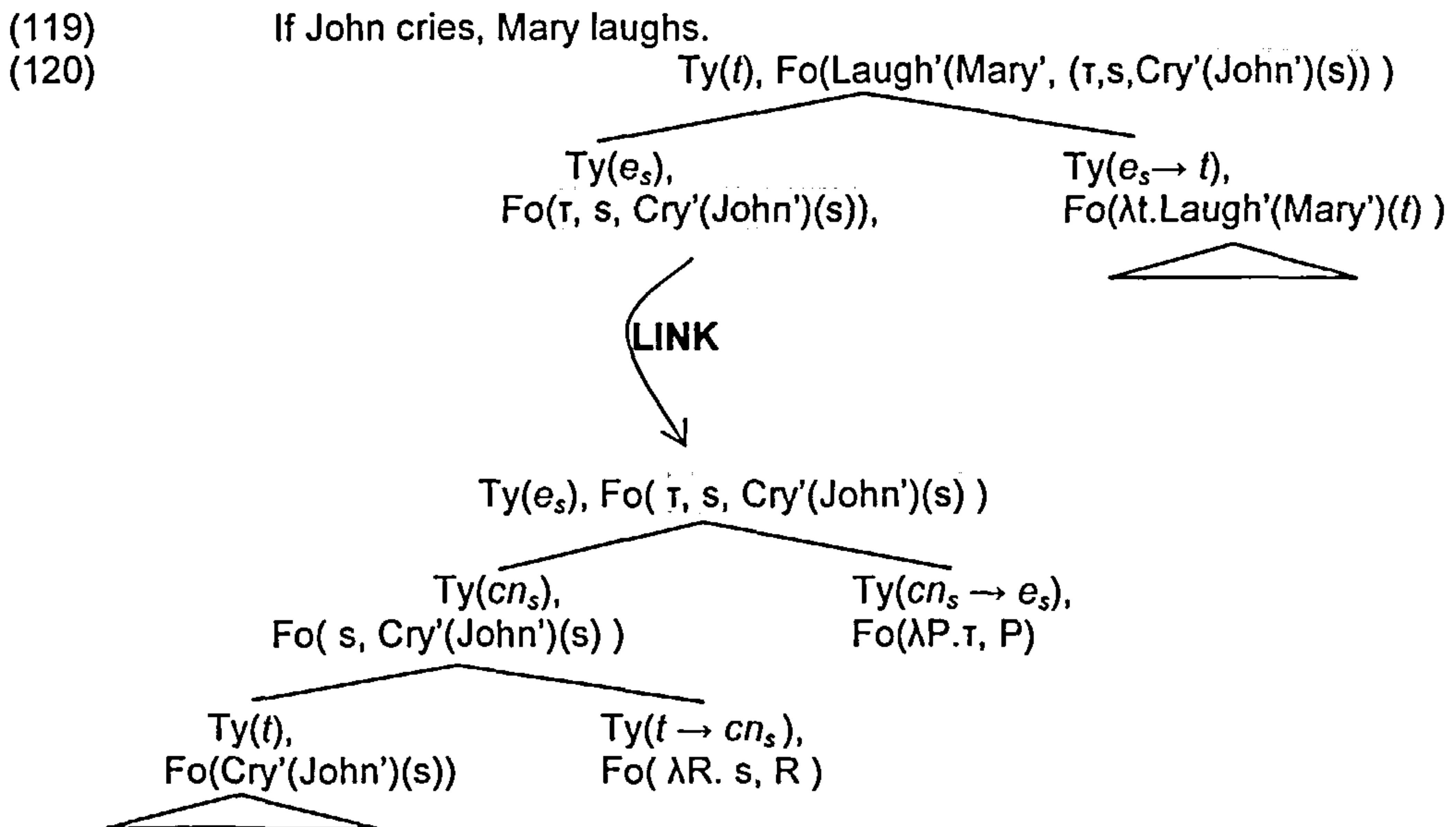
content of the *if*-clause ($q(\tau, s, ps)$). That is, the content of the *if*-clause, p , becomes the Restrictor in a universal quantification over situations (τ, s, ps) whereas q becomes the Nuclear Scope. By the quantificational restructuring rules we also derive a term (a above) which can serve as the situation argument for another proposition or as the replacement for the metavariable contributed by a pronominal.

Since we want to capture the contextual dependency of situational quantification as an instance of *saturation* (modelling e.g. Lycan's 2001 "envisaged" and "real" possibilities) we will assume that the Restrictor itself includes a metavariable that has to be substituted by appealing to the context of utterance. This means that only situations that are considered "relevant" will be included in the set of situations making up the Restrictor. Although we will not include it in the tree representations for simplicity, we assume therefore that the Restrictor includes a metavariable that has to be substituted by the context of utterance: $\tau, s, ps \wedge \mathbf{R}s$. \mathbf{R} is a metavariable that has to be substituted by a predicate of situations (a complex proposition) expressing "what is expected" or "envisaged" given the propositions in the *Discourse Context* (note that the *Discourse Context* is not assumed to contain only information that has been made available by processing linguistic input; in fact it can be extended by means of inference as long as the principle of relevance is satisfied). This will allow us to derive the distinct flavours associated with the meaning of types of conditionals that have been discussed in the literature without having to make syntactic distinctions encoding those differentiations (this assumption is very close to von Fintel's 1994 implementation which also involves propositions seen as sets of situations and intersecting the content of the *if*-clause with the discourse context). For example, Noh (1996) analyses "metarepresentational" conditionals in terms of relevance theory assumptions. Consider the following dialogue which shows a pattern problematic for standard truth-functional accounts of natural language conditionals:

- (118) A: Two and eleven makes thirty
 B: If two and eleven makes thirty, you need more work on maths
 Noh (ibid: 20)

As Noh argues such cases (and many others) can be accommodated if we assume that the antecedent of the conditional is (meta)representing the proposition expressed by the previous utterance as well as the higher-level explicature associated with it. So the proposition expressed by the antecedent is not simply “two and eleven makes thirty” but rather “if you say/believe that two and eleven makes thirty”. For present purposes we can assume that this is a case of saturation: the value given to the metavariable **R** will accommodate the content of this higher level explicature plus any other contextually relevant assumptions. In that respect the proposition expressed by B’s utterance above will be: “All situations in which you believe/say that two and eleven makes thirty ... are situations in which you need more work on maths”.

In more concrete terms, let’s look at the completed tree derived for the string *if John cries, Mary laughs*. The diagram is shown below:



It can be seen that the proposition derived by the processing of the antecedent, *Cry'(John')(s)*, becomes the argument of a function that copies its

situation argument (which must be a free variable) and creates a Restrictor in the appropriate format required for the construction of a τ -term ($s, Cry'(John')(s)$). The τ -binder is then applied to the Restrictor by means of function application and the τ -term is eventually derived ($\tau, s, Cry'(John')(s)$). This term is subsequently copied at the situation node of the main tree and serves as the situation argument there. The proposition decorating the root node of the global tree, $Laugh'(Mary', (\tau, s, Cry'(John')(s)))$, can be interpreted as: *Mary laughs in all situations that John cries* or: *All situations in which John cries are situations in which Mary laughs*. The role of the content of the *if*-clause here is simply to provide the restrictor of the τ -term that ensues by processing the lexical item *if* and the protasis. In that respect there is no separate assertion of the proposition *John cries* which is as it should be according to the desired truth conditions. The formula will be transformed by the quantifier evaluation (*Q-Evaluation*) rules to:

$$Cry'(John')(\alpha) \rightarrow Laugh'(Mary')(\alpha)$$

where $\alpha = \tau, s, Cry'(John')(s) \rightarrow Laugh'(Mary')(s)$

In this configuration a LOT sentence containing the connective \rightarrow is derived at the root node of the main tree without any explicit encoding of it by any natural language lexical item. This connective is the same as the one derived by the parsing of universally quantifying expressions like *every man* and appears in the logical form by similar means (i.e. we assume that material implication is only *part of* the encoded meaning of *if*, the residue is the quantification over situations, so the analysis is richer but not incompatible with the standard material implication interpretations). In the same way as conjoined propositions are derived by linguistic input containing relative clauses it will be seen below that it is the combination of the lexical and computational actions associated with the parsing of a conditional that derive such universally quantified implicational structures. Indeed, under this analysis, conditional sentences are assumed to derive representations of a similar form as nominal relative clauses, in that a term is shared between the two trees. However, although the main tree in nominal relative constructions

provides itself the term to be copied and the LINKed tree provides additional predicative content on that term, here the “relative”, the *if*-clause input, leads to the construction of a term newly introduced to the main structure. In that respect the processing of *if*-clauses resembles, in the nominal domain, *headless relatives* in English and other languages like the following:

- (121) John eats [what(ever) he likes]
- (122) [What(ever) John eats] harms the environment
- (123) John will arrest [whoever called]
- (124) o Giannis xeretise [opion irthe] *Modern Greek*
 the John greeted [who came]
 John greeted [whoever came]

In both type of cases, a term is derived from a secondary tree that is being developed in parallel to the main one. This term is copied to the main tree so as to serve the role of an argument of the predicate in that proposition. As we will see later, the presence of this secondary tree, its attachment to the main structure by the LINK relation and the incorporation of its informational content to the main tree is what explains the subordination features exhibited by *if*-clauses.

We now turn to see the dynamic process that puts all the information together so as to derive the above structures.

4.b.2.Dynamics

4.b.2.a. The lexical entry for if

We now have to define the precise route to be followed by the parser in order to accomplish the construction of the above structure from an input string in the form of a conditional sentence. We start with the instructions stored into the lexical entry for *if*. These are responsible for initiating the building of a new LINKed tree which is going to accommodate the lexical input from the protasis. Because the result of processing the antecedent must be a τ -term of type e_s , the rules in the lexical entry for *if* also initiate additional structure above the linked tree which is going to derive the required term by the usual structure-building means of DS, i.e., type deduction in parallel with function

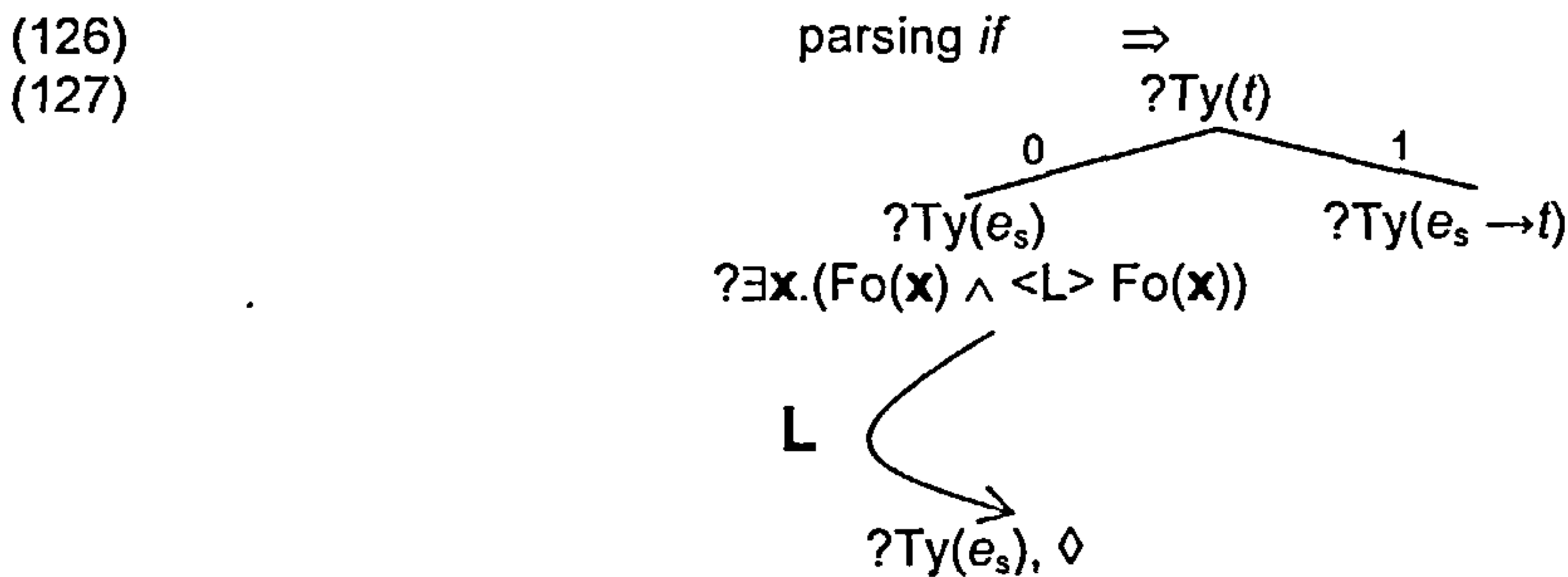
application. The following is the lexical entry triggered by the parsing of the particle *if*.

- (125) *if*
- (1). **IF** $?Ty(e_s)$
 - (2). **THEN** $put(?\exists x.(Fo(x) \wedge \langle L \rangle Fo(x))^{69});$
 - (3). $make(\langle L \rangle); go(\langle L \rangle); put(?Ty(e_s));$
 - (4). $make(\langle \downarrow_1 \rangle); go(\langle \downarrow_1 \rangle); put(Ty(cn_s \rightarrow e_s), Fo(\lambda P.\tau, P); go(\langle \uparrow_1 \rangle);$
 - (5). $make(\langle \downarrow_0 \rangle); go(\langle \downarrow_0 \rangle); put(?Ty(cn_s));$
 - (6). $make(\langle \downarrow_1 \rangle); put(Ty(t \rightarrow cn_s)), freshput(\mathbf{s}, Fo(\lambda R.\mathbf{s}, R)); go(\langle \uparrow_1 \rangle);$
 - (7). $make(\langle \downarrow_0 \rangle); go(\langle \downarrow_0 \rangle); put(?Ty(t));$
 - (8). $make(\langle \downarrow_0 \rangle); go(\langle \downarrow_0 \rangle); put(Ty(e_s); Fo(\mathbf{s}); go(\langle \uparrow_0 \rangle)$
 - (9). **ELSE** abort

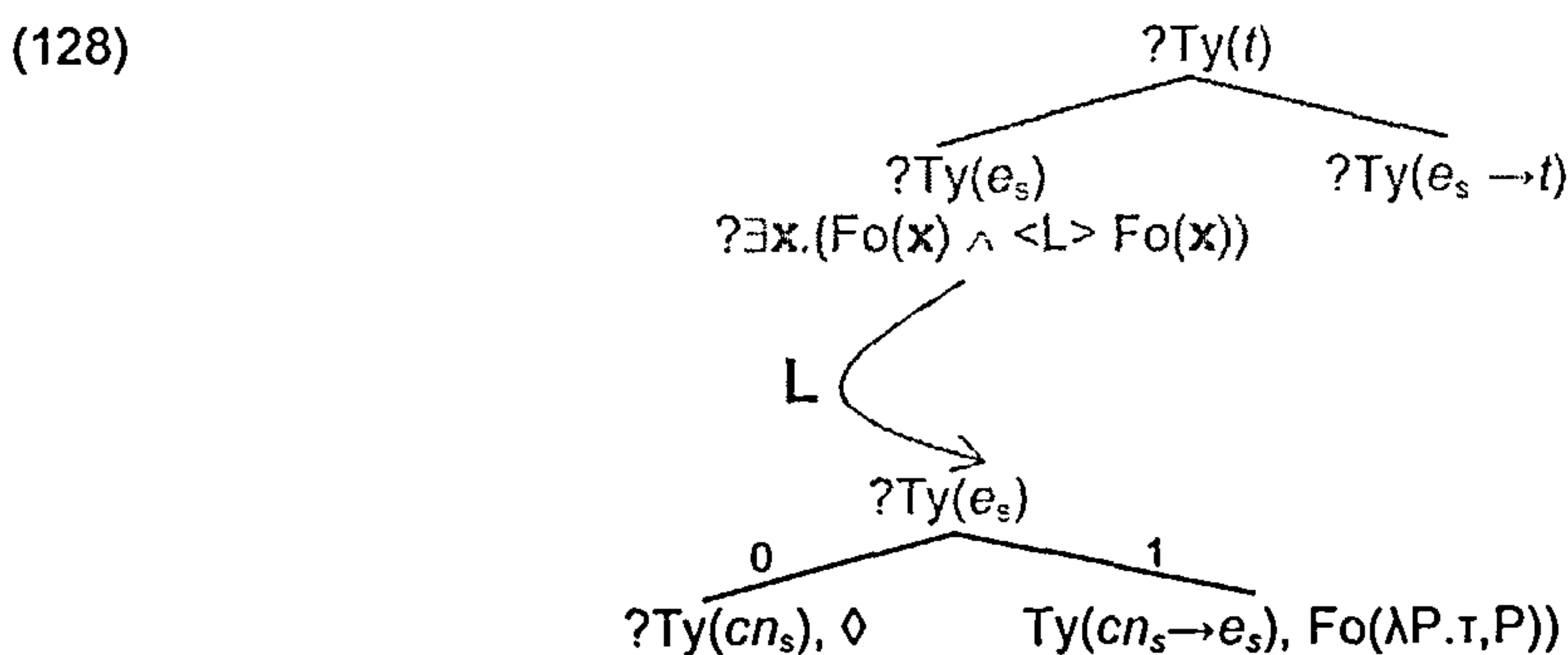
We will illustrate the effect of parsing the lexical item *if* by going through the parsing steps that it induces. Let's start with the parsing of the string *If John cries Mary laughs*. Assuming, as above, that Introduction and Prediction have created the two nodes lying under the $?Ty(t)$ root node the pointer now appears at the left argument daughter where there is a requirement for a node of type e_s to be derived ($?Ty(e_s)$). With this being the case, the condition at line (1) at the lexical entry of *if* above (**IF** $?Ty(e_s)$) is satisfied and the actions specified in the following lines can take place. By line (2) the requirement for a shared formula with a linked node is now inserted here: $?\exists x.(Fo(x) \wedge \langle L \rangle Fo(x))$. The first conjunct of this requirement can only be satisfied by a proper Formula value from the domain D_{Fo} , appearing on the node, i.e., not a metavariable but a proper term. The second conjunct will be satisfied only when the same Formula value appears at a node LINKed to the present one. In combination with the rest of the processing rules this second part of the requirement will narrow down the choice for a Formula value to just a quantificational term newly derived in the LINKed structure. By the

⁶⁹ As Ronnie Cann (pc.) has suggested this complex requirement is redundant given the LINK Evaluation Rule which is the only way to move the pointer back to the main tree. We retain it for illustration purposes.

instructions in line (3) ($\text{make}(\langle L \rangle); \text{go}(\langle L \rangle); \text{put}(\text{?Ty}(e_s))$) a new node connected with the LINK relation to the current one is built and a requirement to derive a term of type e_s is introduced there:



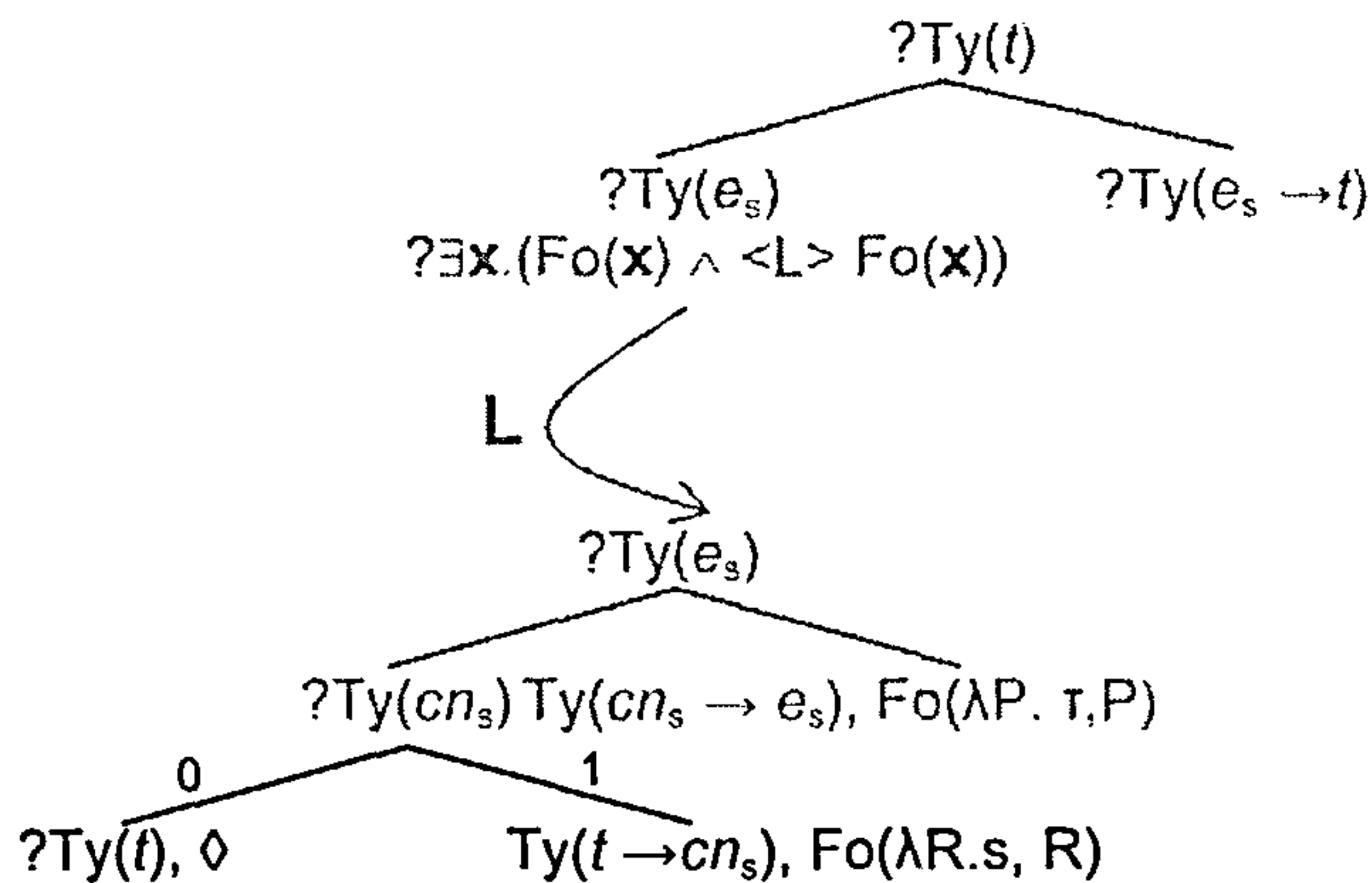
This is the node where the derived τ -term of type e_s will eventually appear. Line (4) ($\text{make}(\langle \downarrow_1 \rangle); \text{go}(\langle \downarrow_1 \rangle); \text{put}(\text{?Ty}(cn_s \rightarrow e_s), \text{Fo}(\lambda P.\tau, P))$), instructs the parser to construct the functor daughter of this node. This is the node where the functor that introduces the τ -binder appears. The sister of this node will provide an argument of $\text{Ty}(cn_s)$, the restrictor for the τ -term. The pointer moves upwards. By line (5), $\text{make}(\langle \downarrow_0 \rangle); \text{go}(\langle \downarrow_0 \rangle); \text{put}(\text{?Ty}(cn_s))$, the node that will accommodate the restrictor for the τ -term is built and a requirement for the appropriate type, a set of situations, is inserted. The structure that is being created is completely equivalent to a nominal quantificational term even though the types are sorted to range over situations:



At line (6) the parser is instructed to introduce another functor daughter this time underneath the current $\text{?Ty}(cn_s)$ node: $\text{make}(\langle \downarrow_1 \rangle); \text{go}(\langle \downarrow_1 \rangle); \text{put}(\text{Ty}(t \rightarrow cn_s))$. This daughter takes as its argument a proposition of type t with a free variable situation argument. The formula value on this node is

introduced as follows: $\text{freshput}(\mathbf{s}, \text{Fo}(\lambda R. \mathbf{s}, R))$. The action *freshput* selects and inserts as a Formula value for a node the first available variable that has not appeared earlier in the global tree being constructed. Therefore it ensures that a fresh variable is always introduced. The variable introduced here by the action *freshput* will be identical to the one introduced as the situation argument of the propositional tree built out of processing the protasis (this is ensured by the employment of bold, lower case variables). The Formula value on this node will bind that variable in order to create a Restrictor of the appropriate shape for the τ -binder at the next level up. The pointer returns to the mother node by the action: $\text{go}(\langle \uparrow_1 \rangle)$. By line (7) the propositional tree for the content derived from the antecedent is initiated; this node will eventually be decorated by a formula of type t and will provide the set of situations quantified over:

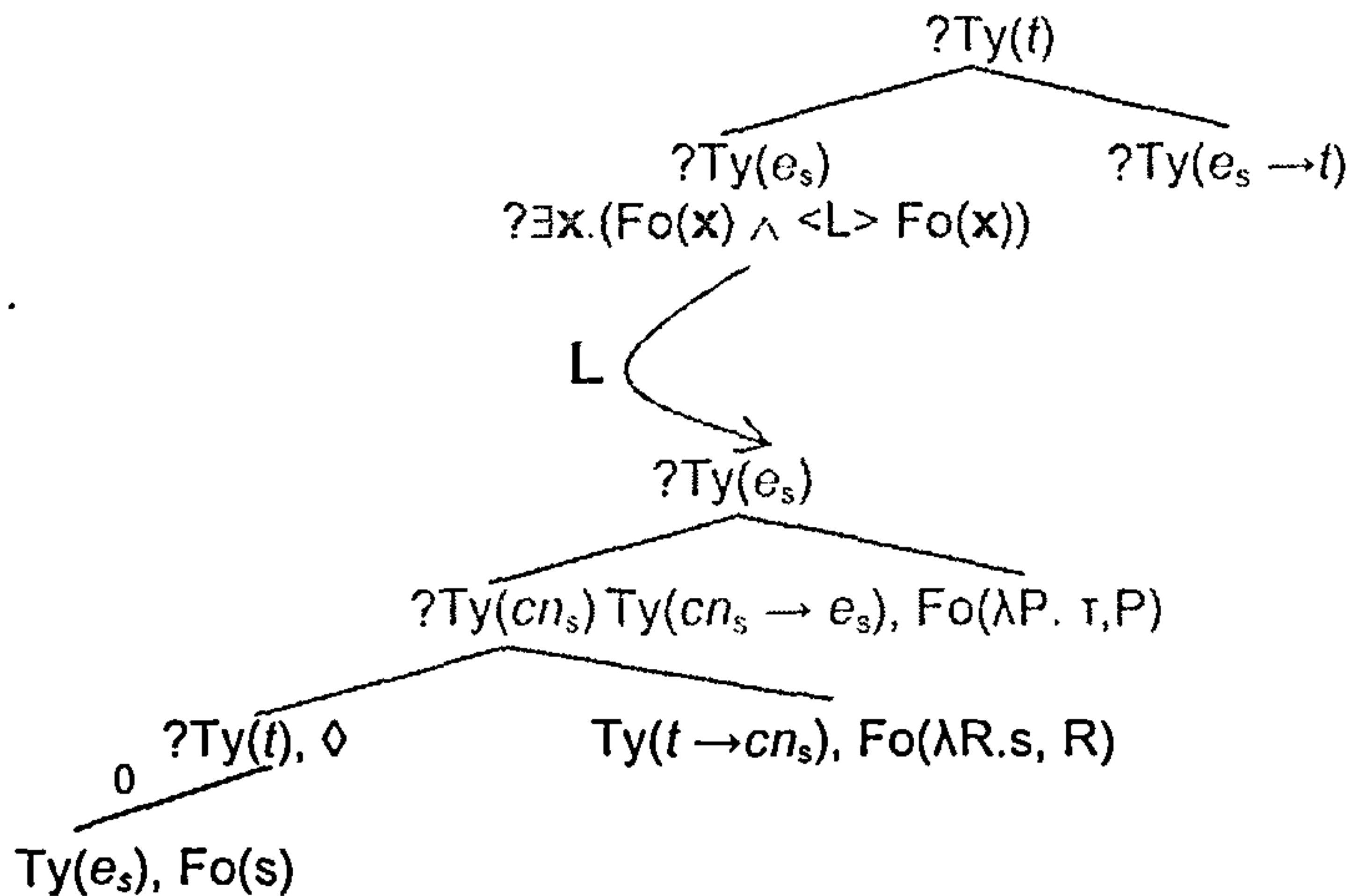
(129)



In all respects the tree derived by the antecedent will be a simple predicate-argument structure of type t . The only differentiation will be that its situation argument will be a free variable instead of the usual situation arguments which are taken to be quantificational terms. The fact that a variable appears there will allow the structure derived to be interpreted as the representation of a set of situations and thus to serve as the restrictor for a quantificational term. We need to make sure that the particular fresh variable selected earlier is indeed the situation argument of the $?Ty(t)$ structure so that it can be bound inside the Restrictor for the τ -term. Line (8) of the lexical rule above ($\text{make}(\langle \downarrow_0 \rangle); \text{go}(\langle \downarrow_0 \rangle); \text{put}(\text{Ty}(e_s), \text{Fo}(\mathbf{s}))$) builds the situation argument

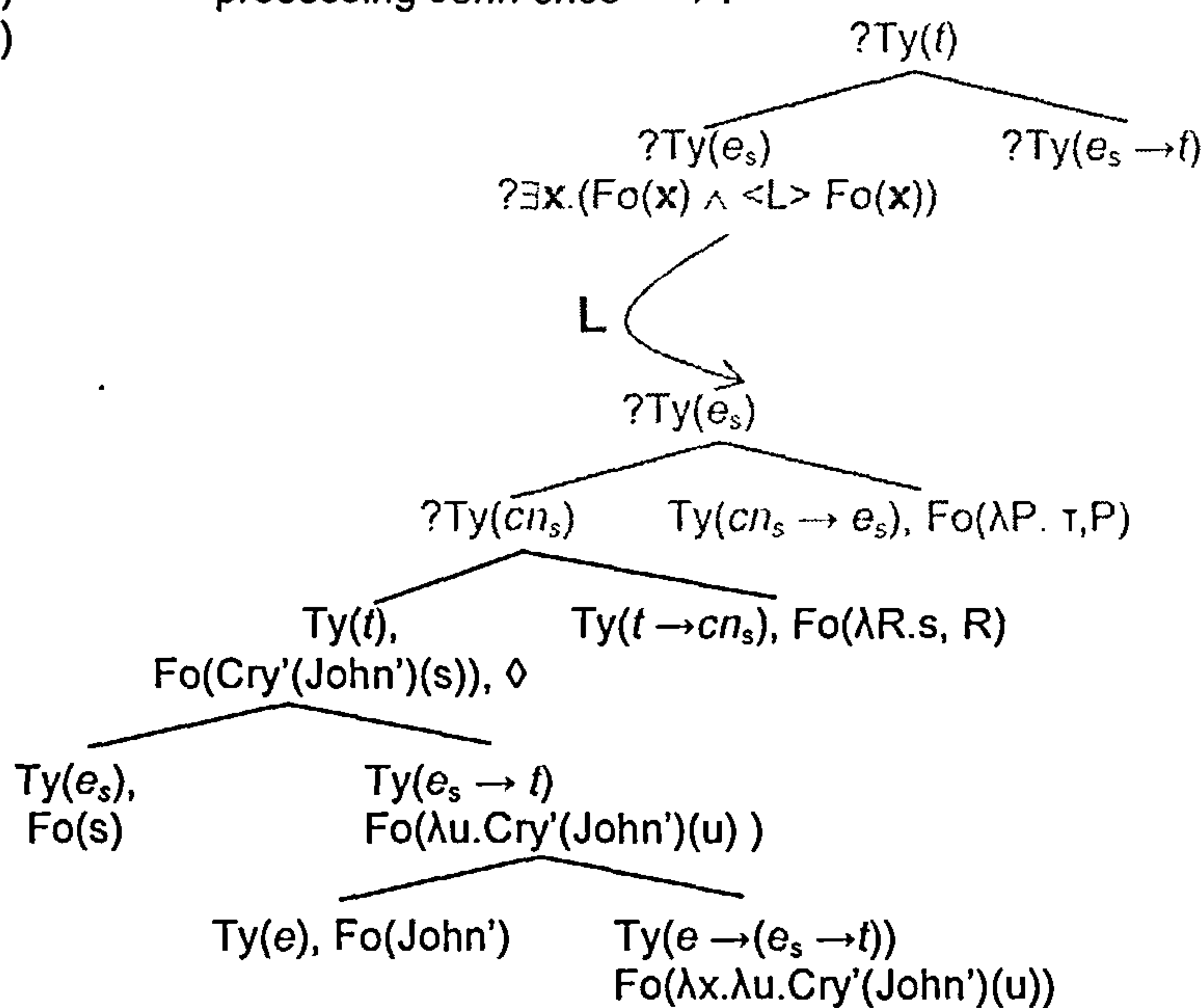
daughter of the $?Ty(t)$ node and inserts the variable selected by *freshput* previously. Additionally the type specification for the node is inserted and the pointer is moved to the mother $?Ty(t)$ node:

(130)



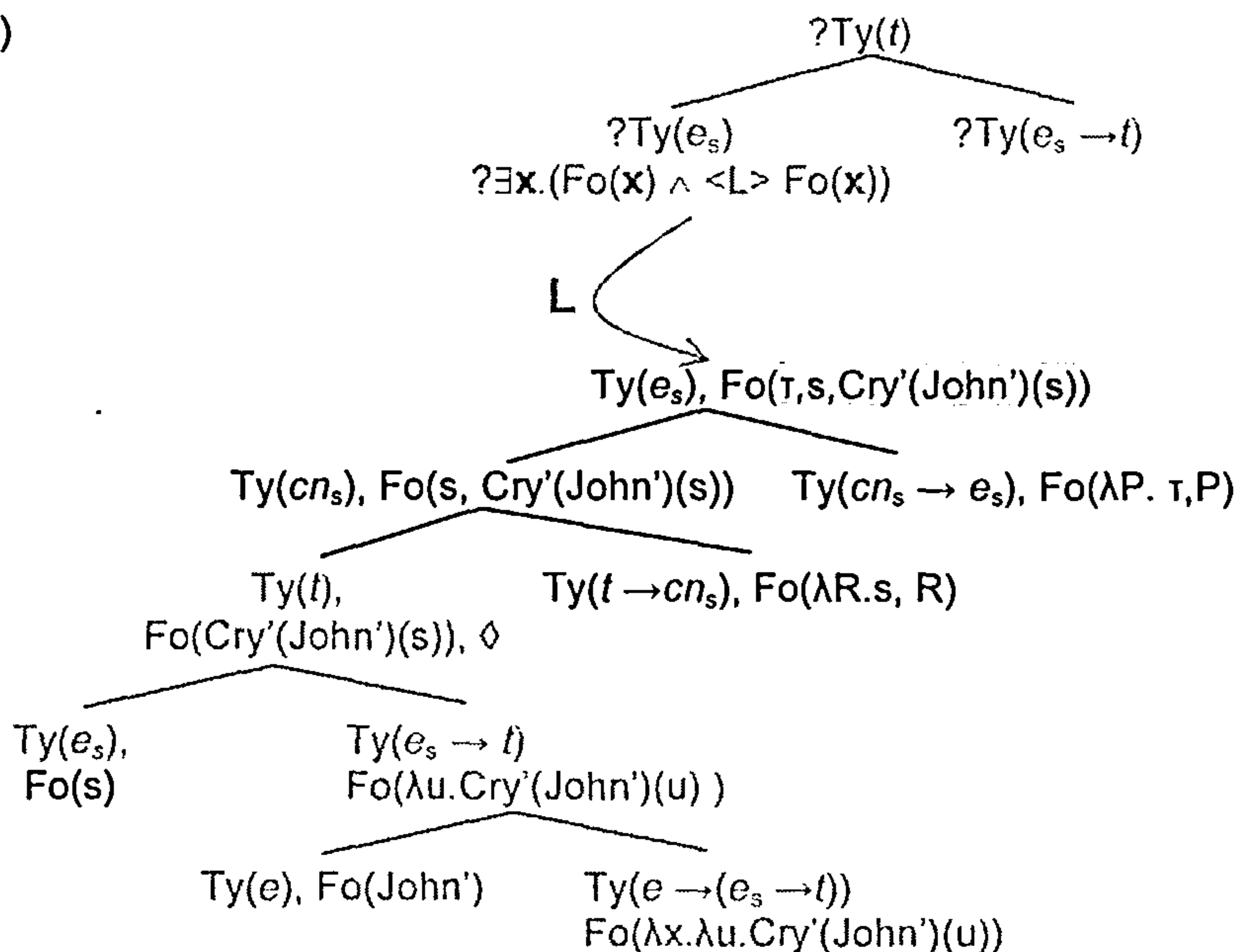
At this point the contribution of the lexical input contributed by *if* has been completed. It has initiated an otherwise ordinary $?Ty(t)$ structure with a fresh free variable as its situation argument. Now the regular parsing processes can take over and continue the processing of the antecedent (the fact that the situation accommodating daughter has already been introduced does not affect the operation of *Introduction and Prediction*). Let's see the structure derived by parsing the string *if John cries*:

(131) processing *John cries* \Rightarrow :
 (132)



At the stage of the parsing shown above the parsing of the antecedent has been successfully completed although in terms of interpretation the representation at the type t node is that of a set of situations, not truth-evaluable as a proposition without further ado. There is also incomplete structure on top of this type t node which connects it with the main tree through a series of daughter and LINK relations. Therefore we now need to finish off the internal nodes so that we can achieve the construction of the required τ -term. The usual rules of function application and type deduction can apply to complete the nodes up to the level at which the LINK relation terminates:

(133)



The newly introduced τ -term has as its restrictor the propositional content derived by parsing the string *John leaves* under the assumption that a free variable was selected as its situation argument. We now proceed to copy this term to the main tree.

4.b.2.b. *Link Evaluation for conditionals*

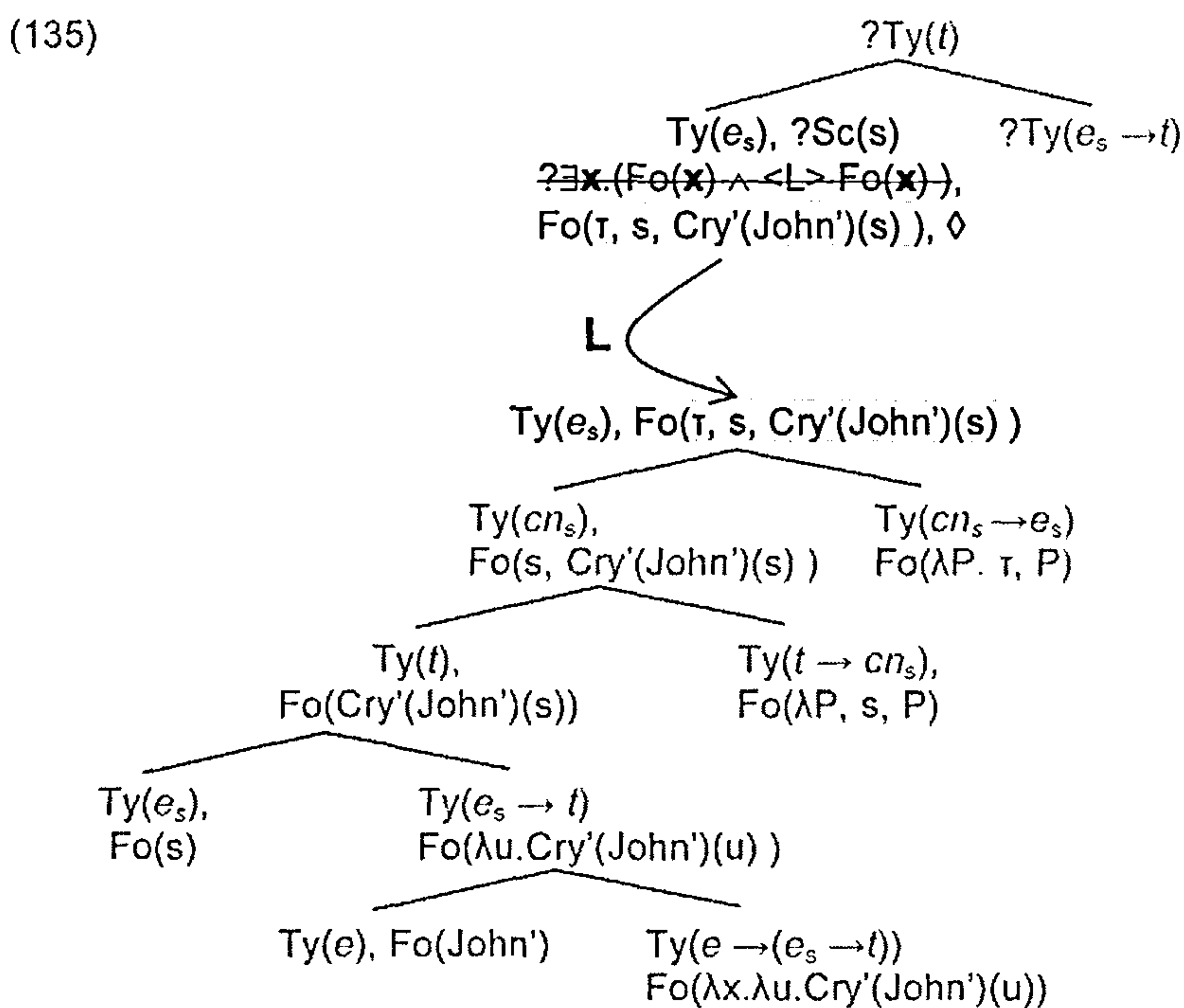
With the required τ -term having been derived we can now continue the processing of the structure. At this point the pointer appears at the top node of the τ -term's subtree. In order to be able to move the pointer back to the main tree and copy the term to its situation node a rule of Evaluation is required. The rule proposed below belongs to the family of rules characterised as *LINK Evaluation* rules. It very simply copies the formula from one node to another one which is related to it by means of the LINK relation; it simultaneously moves the pointer there. In our case the *LINK Evaluation* rule will also introduce a requirement for scope resolution concerning the τ -term ($?Sc(x)$) and an underspecified scope statement at the root node ($Scope(U<x)$):

(134) **LINK Evaluation Rule: Conditionals:**

$$\{ \{ Tn(X), Ty(t), \dots \}, \{ \langle \uparrow_0 \rangle Tn(X), ?Ty(e_s), ?\exists x.Fo(x) \dots \}, \{ \langle L^1 \rangle \langle \uparrow_0 \rangle Tn(X), Ty(e_s) Fo(a_{[x]}), \dots, \diamond \} \dots \} \}$$

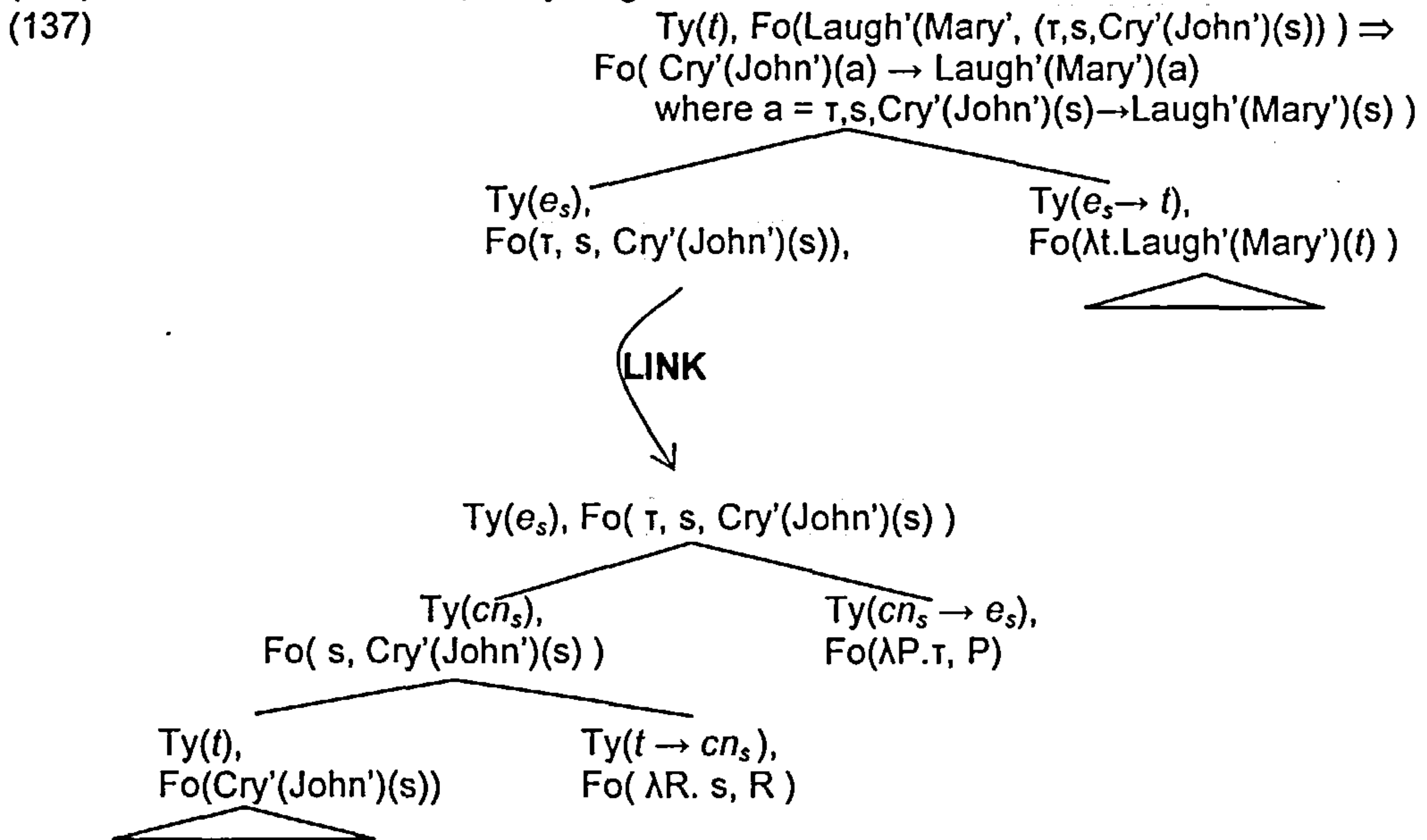
$$\{ \{ Tn(X), Ty(t), \dots, Scope(U \langle x \rangle) \}, \{ \langle \uparrow_0 \rangle Tn(X), ?Ty(e_s), ?\exists x.Fo(x) \dots, ?Sc(x), Fo(a_{[x]}), \diamond, \{ \langle L^1 \rangle \langle \uparrow_0 \rangle Tn(X), Ty(e_s) Fo(a_{[x]}), \dots \} \dots \} \}$$

Application of this rule to the tree above will result in the appropriate copying and the requirement at the situation node can now be satisfied:



The parsing of the consequent can now go on as usual. The final formula derived at the top node of the global tree will be a universal quantification ranging over (contextually restricted) situations at which John cried. For completeness we repeat the tree derived by processing of our example sentence below:

(136) If John cries, Mary laughs.



4.b.2.c. The absence of low construals

The parallel properties of *if*-clauses and nominal relatives have led several researchers to the assumption, which is also adopted here, that *if*-clauses are a type of relative clause in the same way that *when*-clauses and *where*-clauses can be taken as relatives over implicit time or location specifications (see e.g. Geis 1985, Bhatt & Pancheva 2001/2005). Nevertheless there is one difference between these clauses and *if*-clauses. Consider the following:

(138) John left when Mary claimed that Bill left

The above is ambiguous between the following two interpretations:

(139) John left at the time at which, according to Mary, Bill left

(140) John left at the time at which Mary made the following claim: "Bill left"

Unlike *when*-clauses, *if*-clauses are not ambiguous in that respect:

(141) John left if Mary claimed that Bill left.

(142) In any case that is such that Mary made the claim: "Bill left", John left (in that case)

(143) # John left in any one of the circumstances that Bill left according to Mary's claims

This is captured in the present analysis because the initiation of the LINKed tree has been assigned to the actions associated with the word *if*. So it can be seen that the situation argument is created immediately as a fixed node on the new tree. In contrast, for *when*-clauses/*where*-clauses, as in nominal relatives, we can assume that the situation argument is constructed as initially unfixed, hence the low construals.

We now turn to examine how the other syntactic properties of conditional sentences are accounted for under this analysis.

4.b.3. Linear order

In this section we discuss the two main linear positions where an *if*-clause can appear: (i) sentence-initially, and, (ii) sentence-finally. Both these positions can be accounted for without further ado with the rules postulated and the usual processing machinery afforded by DS.

First of all we have to account for the fact that an antecedent may be related long-distance to its consequent:

- (144) If Mary is late again John believes/said/has requested that we should fire her
- (145) If she wins the lottery Mary has promised John that she will buy him a present

In order to process such structures we need to assume that the content of an *if*-clause can be developed at an unfixed node. On the other hand an *if*-clause can appear post-verbally:

- (146) John believes/said/has requested that we should fire Mary if she is late again

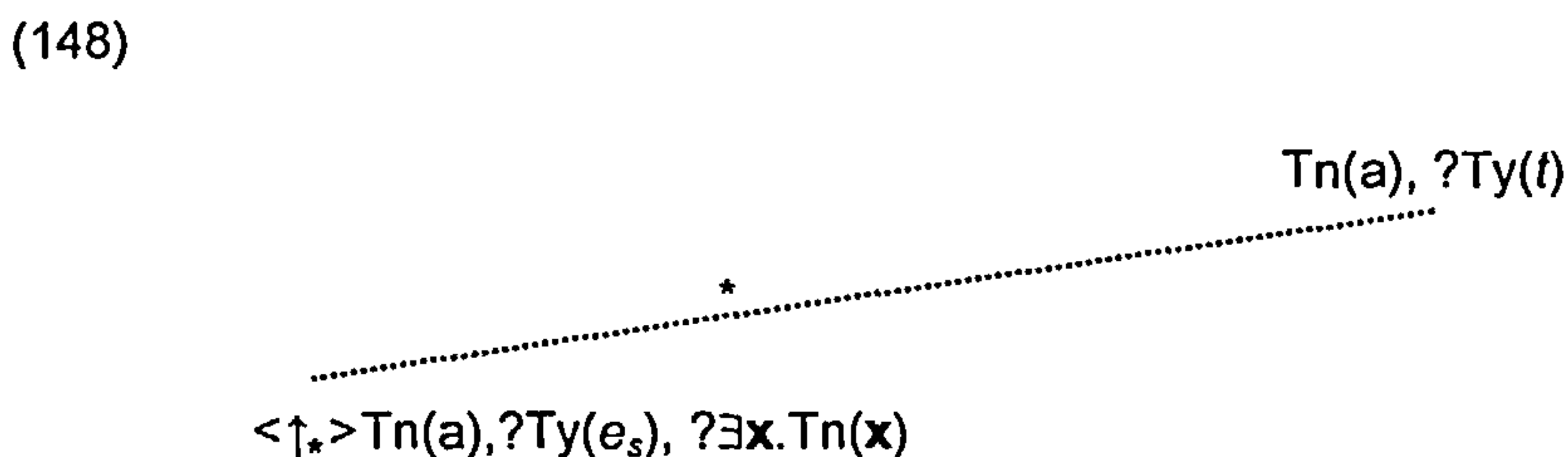
We can account for both structures with the current rules if we assume that both types of position indicate that the *if*-clause can be parsed as an unfixed node introduced either by **-Adjunction* or by *Late *-Adjunction*. Let's see how this will work.

4.b.3.a. Case 1. Sentence-initial if-clause

In these cases we can assume that the $?Ty(t)$ node introduced as the *Axiom* bears the pointer. If the antecedent occurs sentence-initially the rule of **Adjunction*, can apply and introduce an unfixed node of type e_s ($?Ty(e_s)$)⁷⁰.

$$(147) \quad \frac{\text{*Adjunction} \quad \{ \{ Tn(X), ?Ty(t), \diamond \} \}}{\{ \{ <\uparrow_*>Ty(X), ?\exists x.Tn(x), ?Ty(e_s), \diamond \}, \{ Tn(X), ?Ty(t) \} \}}$$

Diagrammatically we can see the creation of the unfixed node in the following tree which is the initial point of parsing without any lexical input:



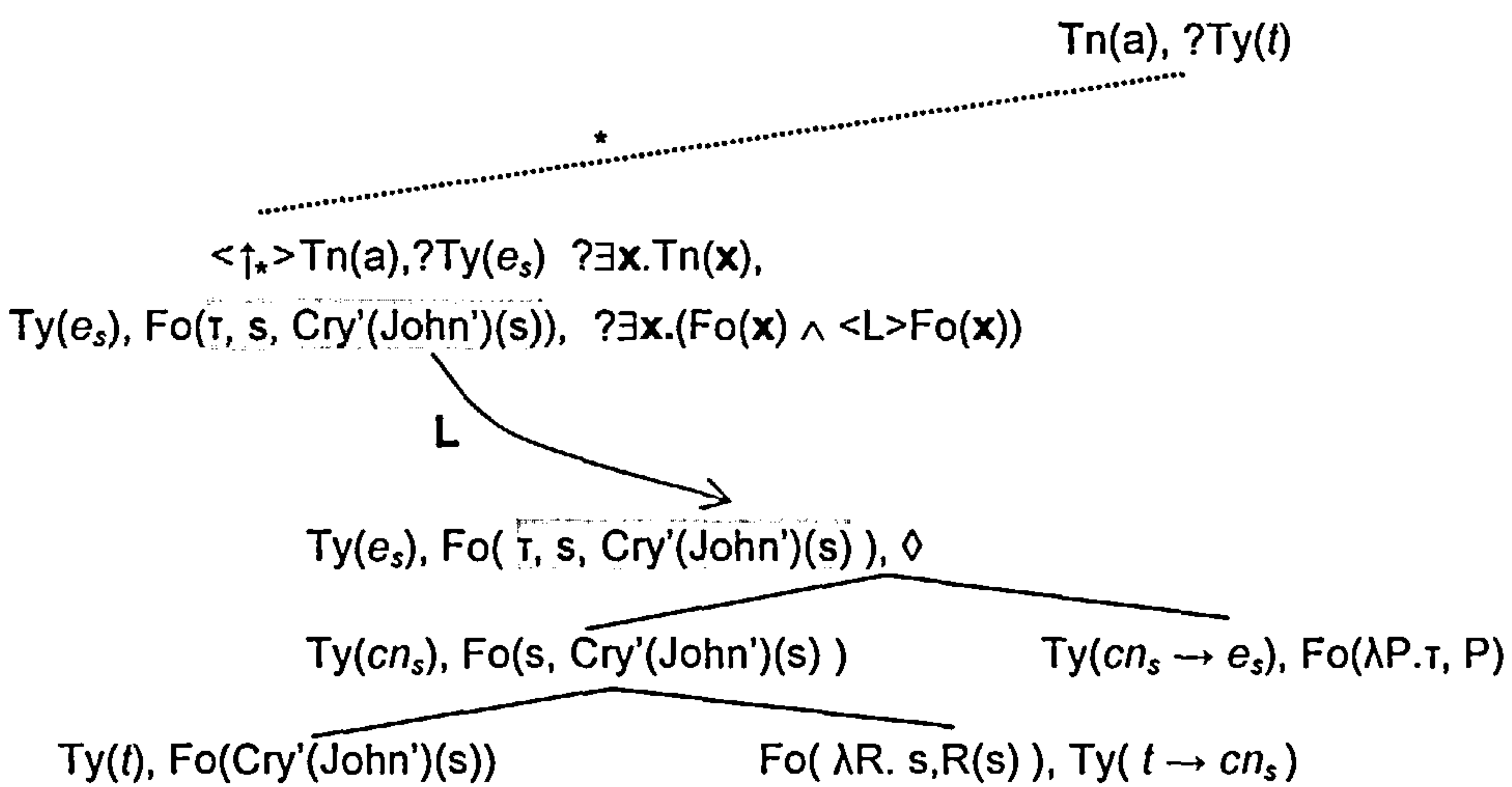
As soon as this happens, we are ready to process lexical input since the pointer is in an environment matching what is required for application of the instructions in the *if* lexical entry (see line (1) in (125) above repeated below):

- (149) *if*
- | | | |
|------|-------------|--|
| (1). | IF | $?Ty(e_s)$ |
| (2). | THEN | $put(?\exists x.(Fo(x) \wedge <L> Fo(x)));$ |
| (3). | | $make(<L>); go(<L>); put(?Ty(e_s));$ |
| (4). | | $make(<\downarrow_1>); go(<\downarrow_1>); put(Ty(cn_s \rightarrow e_s), Fo(\lambda P.\tau, P); go(<\uparrow_1>);$ |
| (5). | | $make(<\downarrow_0>); go(<\downarrow_0>); put(?Ty(cn_s));$ |
| (6). | | $make(<\downarrow_1>); put(Ty(t \rightarrow cn_s)),$
$freshput(s, Fo(\lambda R. s, R)); go(<\uparrow_1>);$ |
| (7). | | $make(<\downarrow_0>); go(<\downarrow_0>); put(?Ty(t));$ |
| (8). | | $make(<\downarrow_0>); go(<\downarrow_0>); put(Ty(e_s); Fo(s); go(<\uparrow_0>)$ |
| (9). | ELSE | abort |

⁷⁰ Remember that we have defined the type e as being the more general category covering both individual entities and situations.

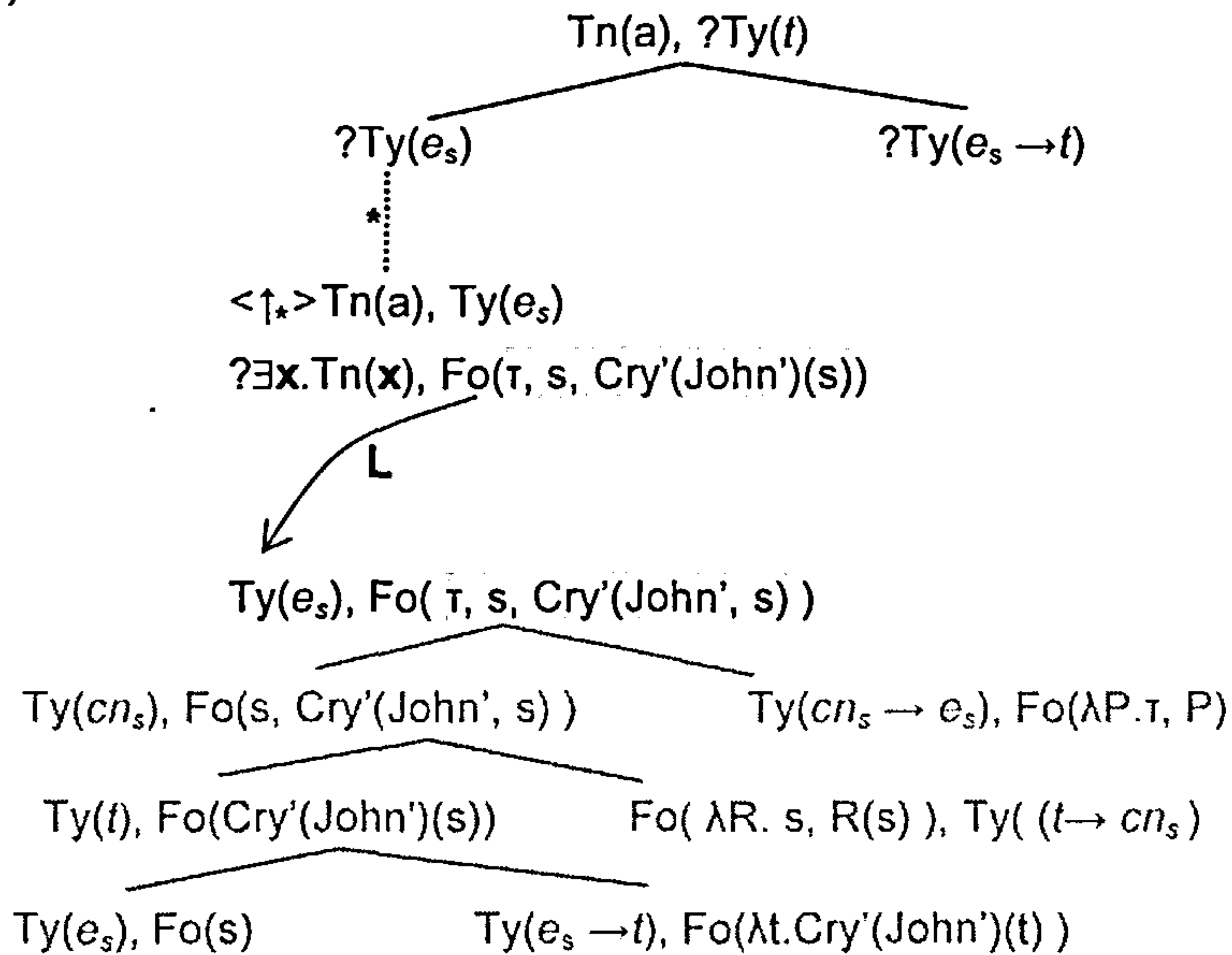
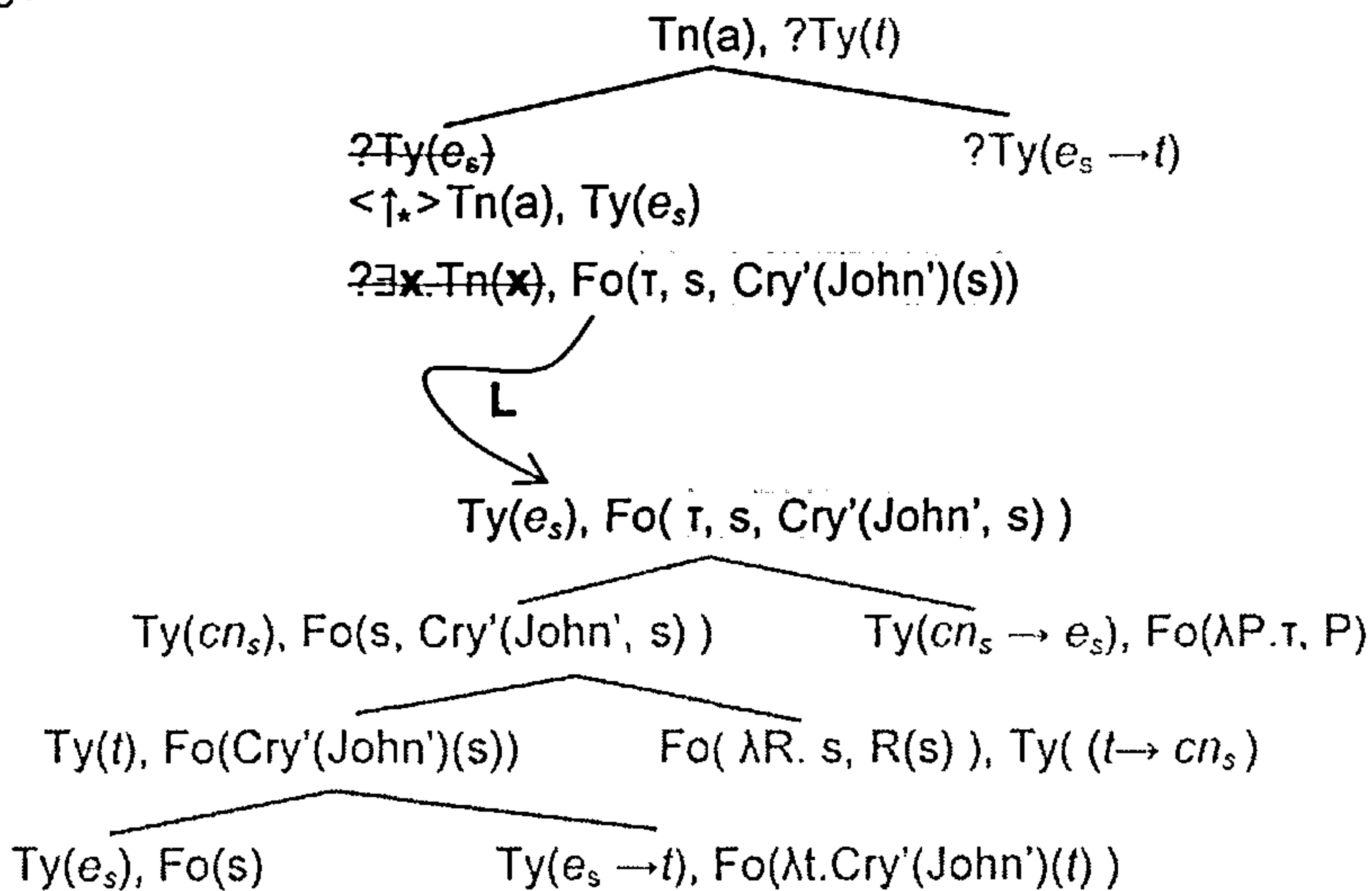
Since the condition is met the instructions can apply at this point. A requirement will be inserted at the unfixed node that a formula value for it must be found at the root of a LINKed tree. The construction of the new LINKed tree will also be initiated and completed up to a point where the standard procedures can take over. A fresh variable ranging over situations will be introduced and will eventually end up bound by the τ -binder. The antecedent can then be processed and the LINKed tree will be completed as was shown above. The completed structure before processing of the main tree resumes is shown below:

(150) *If John cries* \Rightarrow



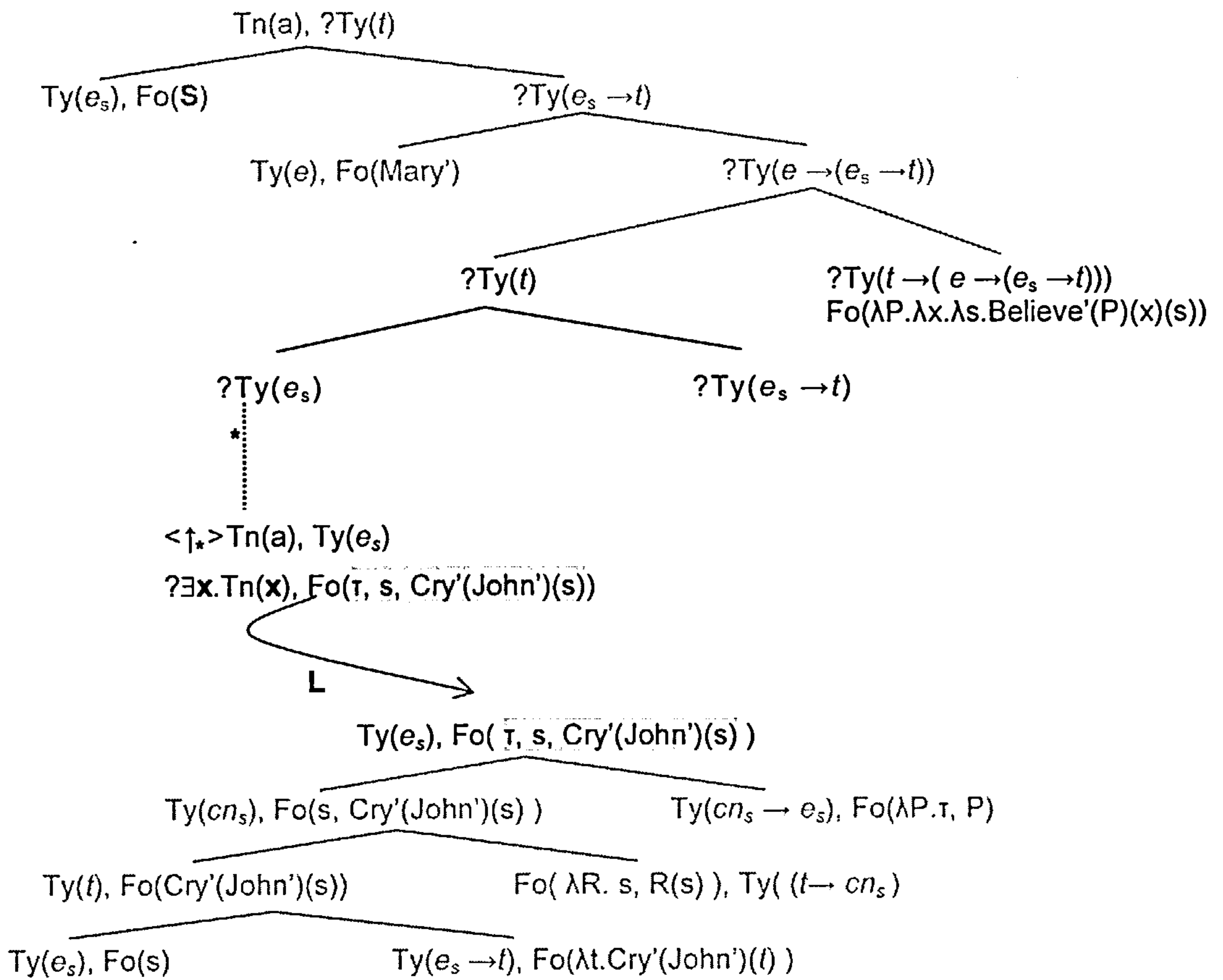
At this point the rule of Completion will move the pointer to the $?Ty(t)$ node and Introduction and Prediction will construct a situation node and its sister. With the pointer at the situation node Merge can apply to unify it with the unfixed node:

(151)

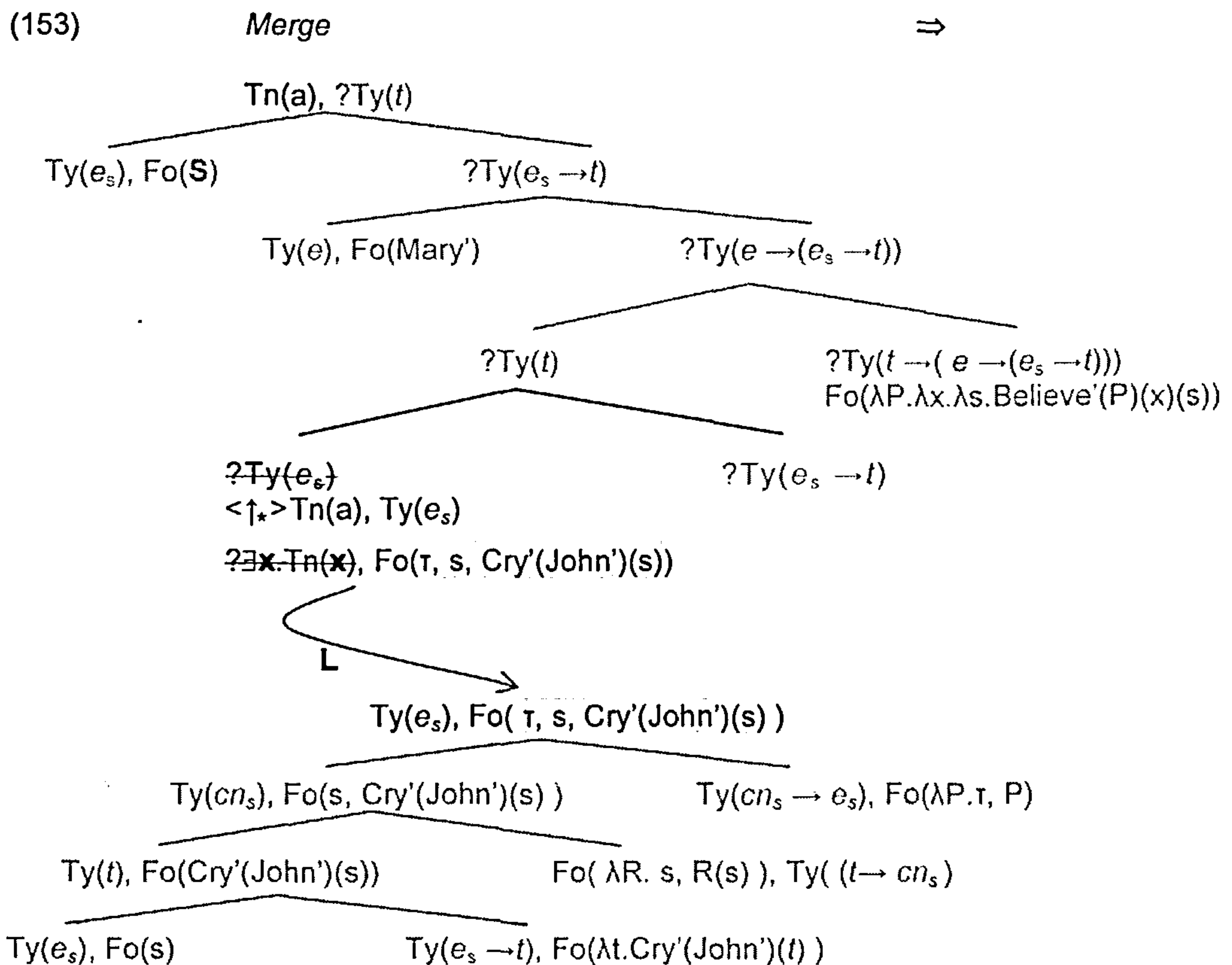
Merge \Rightarrow 

Alternatively, Merge, which is an optional operation will not apply at this node and the unfixed node will be progressively carried down the tree and merge with the situation node of an embedded structure. The tree shown below displays the stage just before Merge has applied:

(152)

If John cries, Mary believes that \Rightarrow 

After Merge has occurred this is the structure that will ensue:



The procedures defined here explain why the processing of strings like below might result in two distinct readings, represented by two distinct trees:

(154) If John cries Sue believes that he just pretends.

The string above is ambiguous. It has at least the following two readings:

- (a) Sue has the following belief: all situations where John cries are situations where he just pretends, or
- (b) all situations where John cries are situations where Sue has the belief that he just pretends.

The two readings are derived in our analysis by assigning to the processing of the sentence two distinct structures. The first reading results when the unfixed situation node that has been created initially and which carries the LINK structure along with it merges with the situation node of the tree created by the processing of the clause which is the object of the verb *believe* (see

(153)). The second reading is derived if the unfixed situation node is merged with the situation node of the tree derived by the processing of the matrix clause (see (151)).

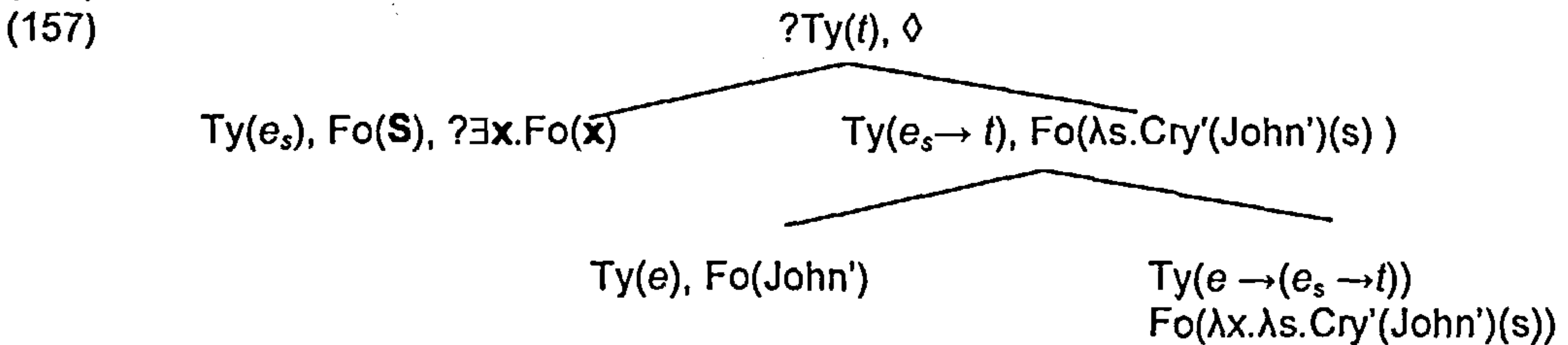
4.b.3.b. Case 2. Post-verbal if-clause

If the antecedent appears post verbally as in (155) below

(155) John cries if he is upset

then the main tree will have been completed up to the node $Ty(e_s \rightarrow t)$ before processing of the *if*-clause starts:

(156) John cries \Rightarrow

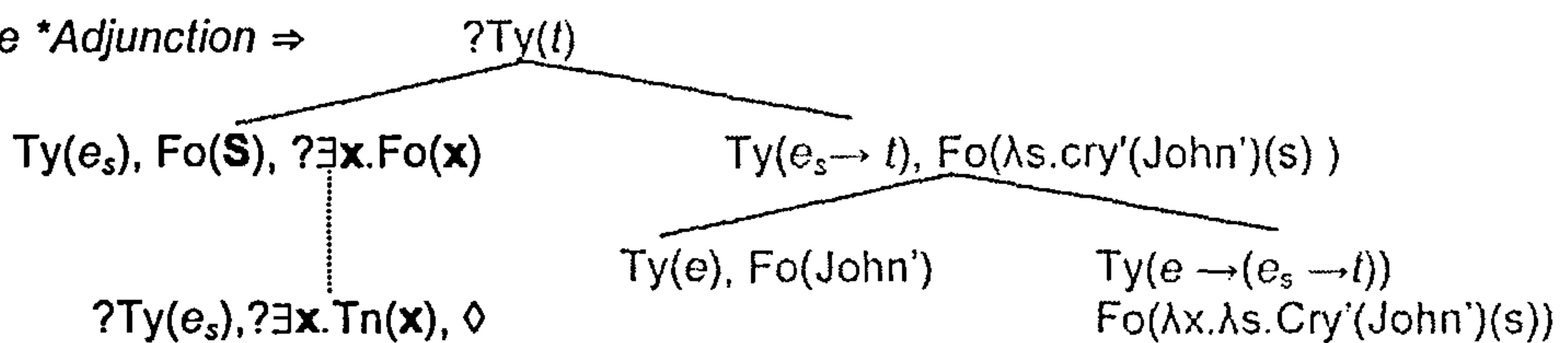


With the pointer at the $?Ty(t)$ node Anticipation can apply since there is a requirement for a proper formula value at $Ty(e_s)$ daughter right below. Once the pointer is at the $Ty(e_s)$ daughter the rule of Late *Adjunction, repeated in (158) below, creates a locally unfixed copy of the $Ty(e_s)$ node:

(158) Late *Adjunction

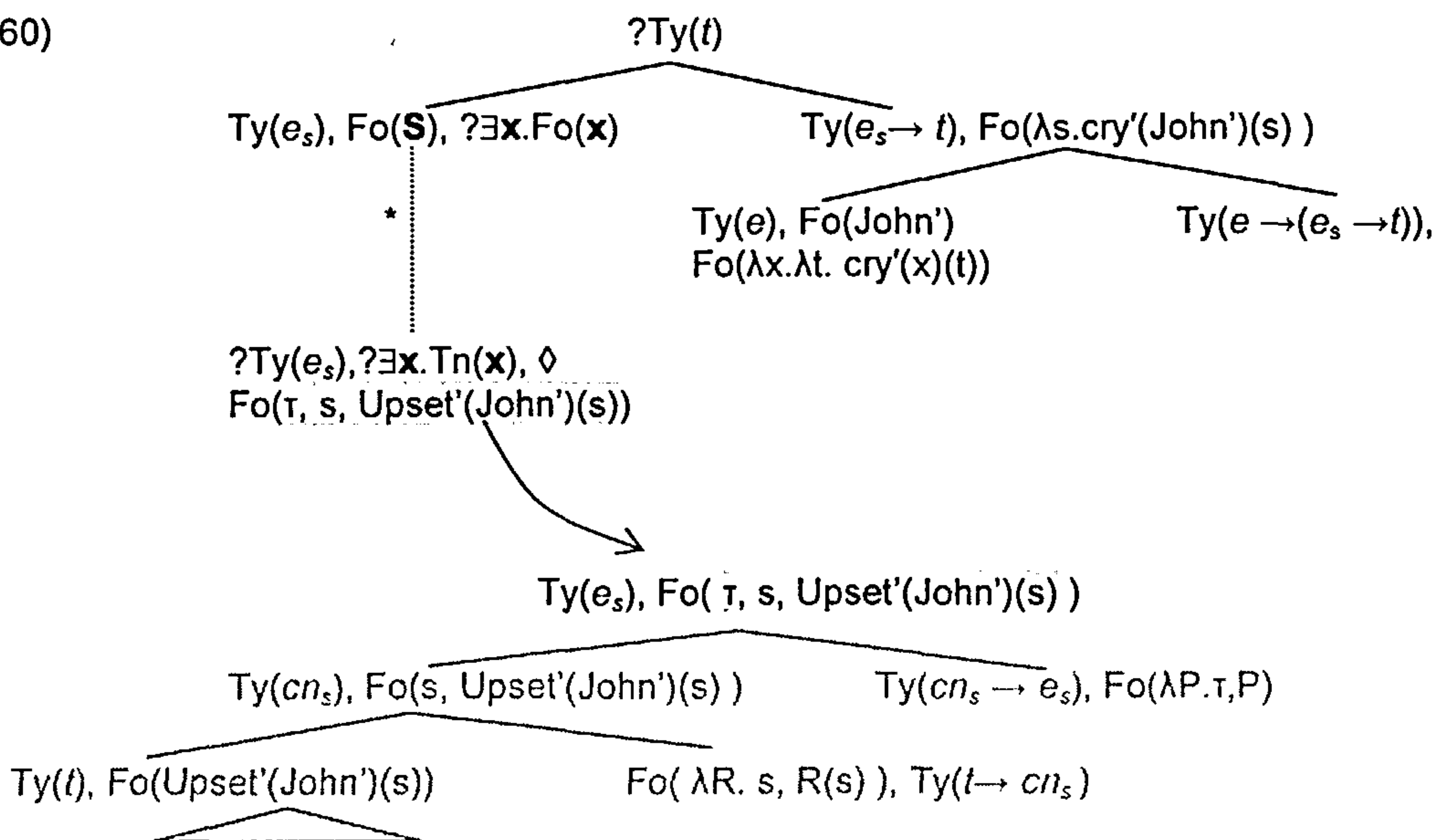
$$\frac{\{ \dots \{ Tn(X), Ty(x), \Diamond \} \dots \}}{\{ \dots \{ \langle \uparrow_* \rangle Ty(X), ?\exists x.Tn(x), ?Ty(x), \Diamond \}, \{ Tn(X), Ty(x) \} \dots \}}$$

(159) Late *Adjunction \Rightarrow

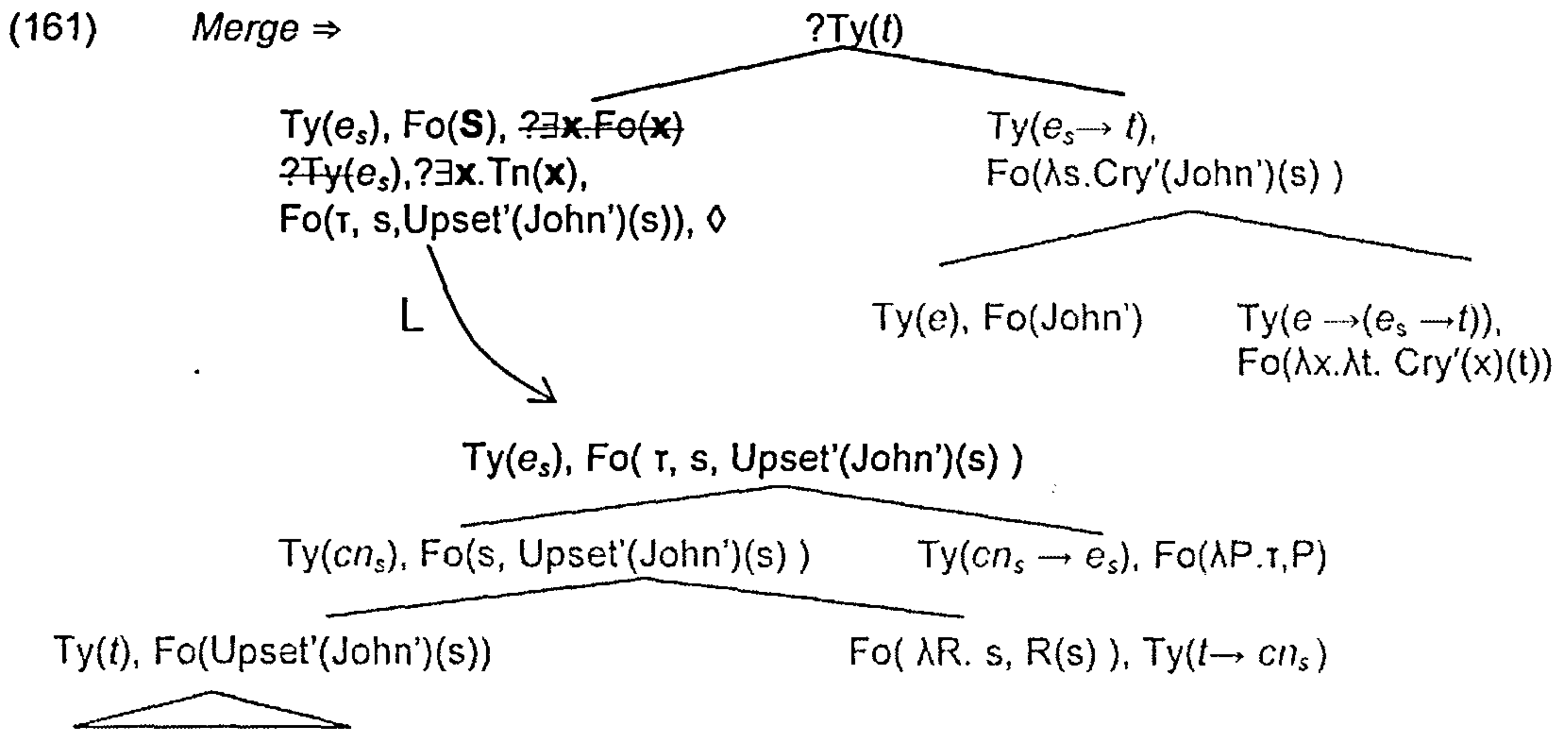


After application of this rule again we have created an appropriate context matching what is required for the processing of the word *if* in (125). As above, a LINKed tree is constructed from this node and the process and outcome are exactly the same as in the previous cases. The only difference will be that the unfixed node is constructed locally, so that it becomes completed and merges with its mother before any processing of the main tree resumes. Below is the state of the tree after processing of the *if*-clause but before Merge has occurred. As we can see the tree is identical to the one in (151) except for the fact that the nodes decorated with the subject and the predicate of the main tree have been completed:

(160)



Merge can now occur so that both the requirements at the unfixed node and at the fixed node can be satisfied:



After Merge Completion and Evaluation will finish the main tree and the result will be indistinguishable to the tree derived by processing a preverbal *if*-clause like *If John is upset John cries*. Thus, even with post-verbal *if*-clauses, the processing and completion of the tree derived from the antecedent will have been finished before completion of the tree derived from the consequent. This is as it should be as it is assumed that the antecedent provides a restriction for the situation argument for the main proposition which therefore cannot be completed until that argument is provided. The lexical entry for *if* derives this outcome by allowing the *if*-clause to be processed, if not sentence-initial, only when the pointer is located at the situation argument node of the main tree just before its completion. An additional effect that will be discussed in a later chapter is that this method of processing will provide an explanation for the anaphoric links associated with the processing of antecedent and consequent.

4.b.3.c. Parenthetical *if*-clauses

Another issue that needs to be addressed now is what kind of connection there is between the consequent and a parenthetical *if*-clause.

- (162) If John shouts, Mary gets extremely upset.
 (163) Mary gets extremely upset if John shouts.

- (164) Mary, if John shouts, gets extremely upset
 (165) If Sue raises, Bill will call⁷¹. from Abbot (2005: 9)
 (166) Bill will call, if Sue raises. (ibid)
 (167) Bill, if Sue raises, will call. (ibid)
 (168) Bill will, if Sue raises, call. (ibid)

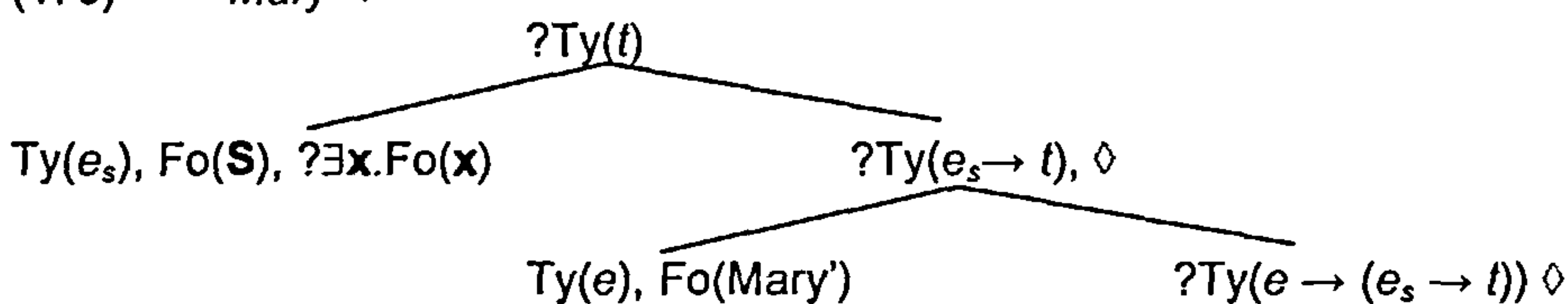
It seems that such *if*-clauses, like other parentheticals, can appear in different positions within the clause⁷². Since such *if*-clauses are assumed to modify a distinguished argument in the proposition they are processed in parallel with we can allow them to exploit the same *Late *Adjunction* option as post-verbal *if*-clauses. To implement this first we need to introduce a rule which will move the pointer from a predicate node to the node hosting the (still incomplete) situation argument:

(169) **Parenthetical Structure Pointer Movement Rule**⁷³

IF $?Ty(e \rightarrow (e^* \rightarrow t))$
THEN **IF** $\langle \uparrow_* \rangle \langle \downarrow_0 \rangle Ty(e_s), ?\exists x.Fo(x)$
THEN $go-first(?Ty(t)); go(\langle \downarrow_0 \rangle)$
ELSE abort
ELSE abort

The input to such a rule could be the schematic tree constructed after parsing the initial constituent of (164):

(170) Mary \Rightarrow



⁷¹ "raise" and "call" should be taken here as poker terms (R. Cann pc.)

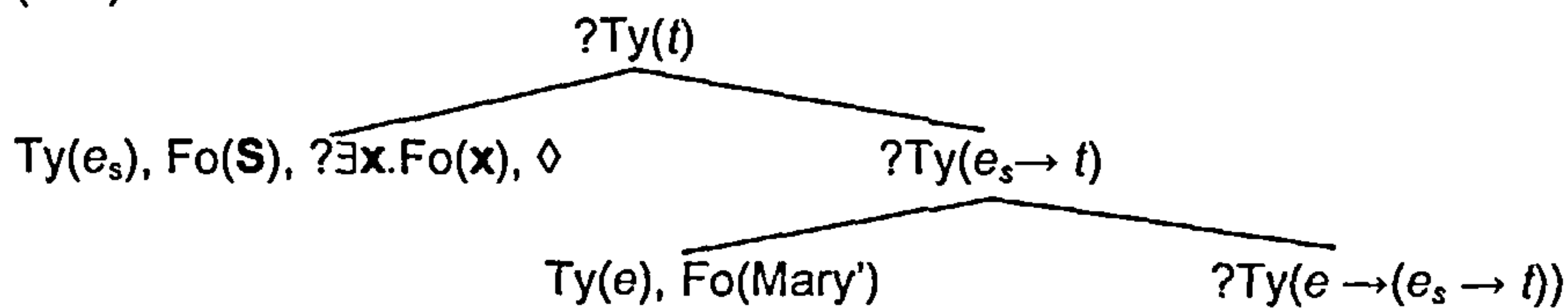
⁷² The position intervening between the direct object and the verb seems to be excluded unless the object is "heavy":

(i) John will buy, if he has enough money, that nice painting at the exhibition.

⁷³ Remember that the vocabulary of lexical actions and computational rules is exactly the same and it is only for presentation purposes that computational rules are sometimes given as input-output clauses. The notation e^* exploits the Kleene star operator to refer to a predicate with an underspecified number of arguments (cf. Marten 1999). Remember also that we use e as a super-type covering all types of arguments, individuals and situations.

Wherever the pointer appears, after application of the rule it will move to the situation argument node:

(171)



The context where the pointer appears now is appropriate for Late *Adjunction to apply:

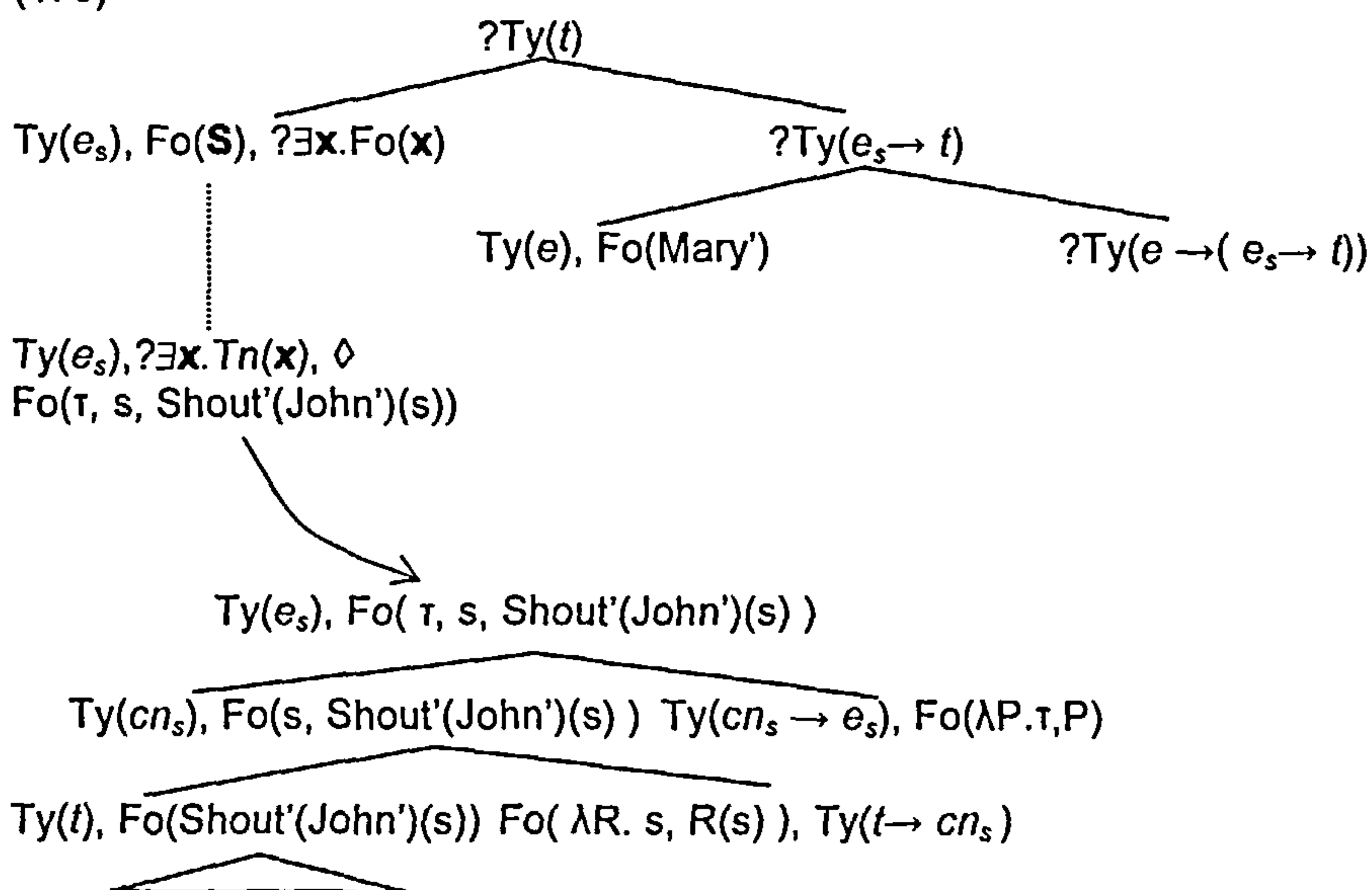
(172)

Late *Adjunction

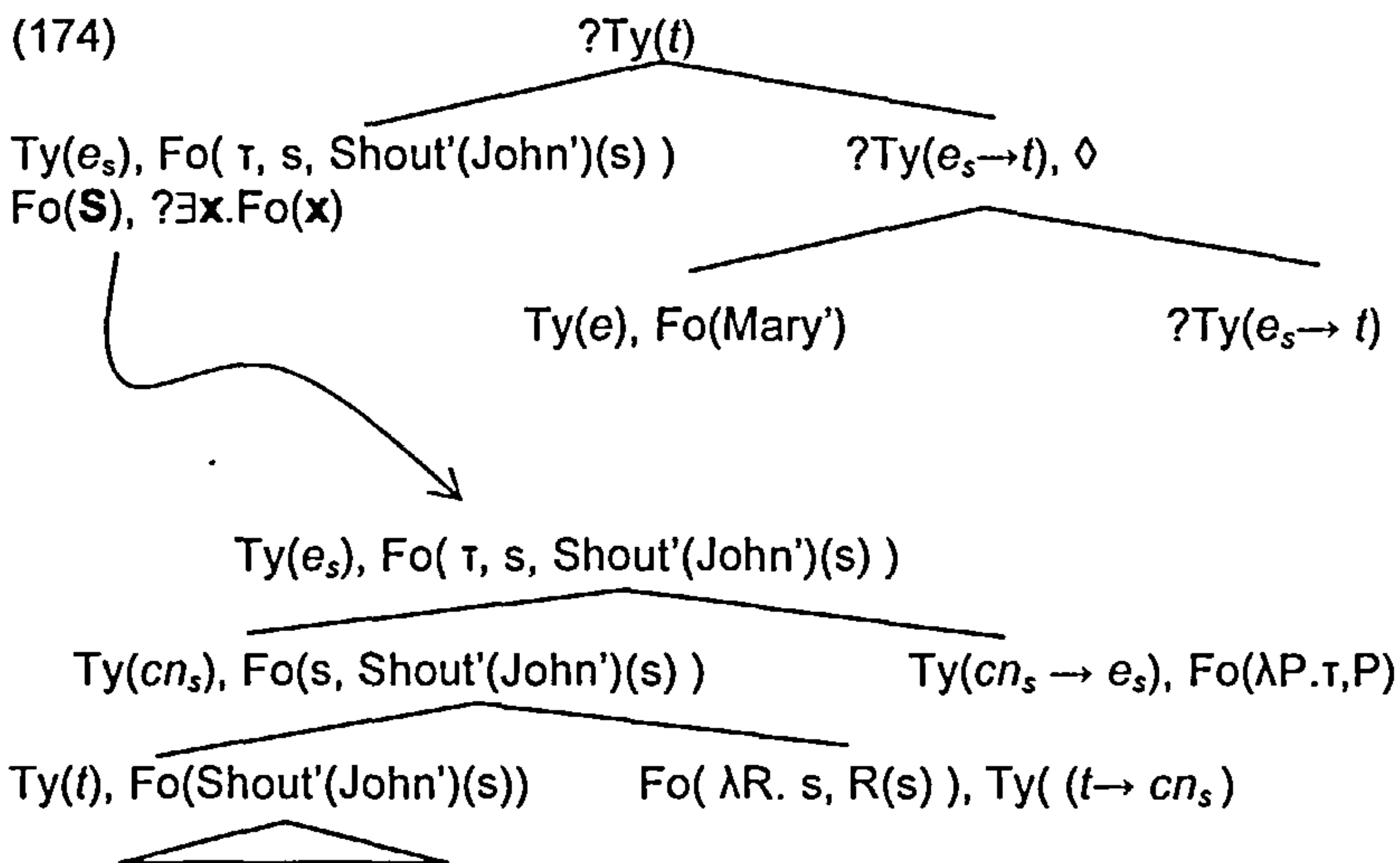
$$\frac{\{ \dots \{ \text{Tn}(X), \text{Ty}(x), \diamond \} \dots \}}{\{ \dots \{ \langle \uparrow_* \rangle \text{Ty}(X), \text{?}\exists \mathbf{x}.\text{Tn}(\mathbf{x}), \text{?Ty}(x), \diamond \}, \{ \text{Tn}(X), \text{Ty}(x) \} \dots \}}$$

The locally unfixed node can be built and the instructions included in the lexical entry for *if* can be executed. The *if*-clause can then be processed to derive the τ -term through the familiar mechanisms:

(173)



Completion will move the pointer to the higher $\text{Ty}(e_s)$ node where Merge can occur. Now with the requirement for a Formula value for the $\text{Ty}(e_s)$ node satisfied the pointer can return to the continuation of the processing of the apodosis by means of Completion and Anticipation:



After all the information has been compiled on the nodes the resulting logical form will have exactly the same truth conditions as the one derived by all the following strings:

- (175) If John shouts, Mary gets extremely upset.
- (176) Mary gets extremely upset if John shouts.
- (177) Mary, if John shouts, gets extremely upset.
- (178) Mary gets, if John shouts, extremely upset.

We have now provided ways of processing preverbal, postverbal and sentence-medial *if*-clauses by utilising a single lexical entry for *if* and without introducing any new processing methods to the DS toolbox except the assumption that the situation of evaluation can be processed as a regular (potentially optional) type *e* argument. We will now turn to examine whether the rest of the apparatus utilised by DS for the processing of arguments contributed by nominals can be also employed for the processing of conditionals and whether we need any extensions or additions to it or our current assumptions about the lexical contribution of *if*.

CHAPTER 6

IF-CLAUSES AS TOPICS

1. Haegeman (2001), (2003):

Event Conditionals vs. Premise Conditionals

Haegeman (ibid) distinguishes between two types of conditionals: (a) *event conditionals* in which the *if*-clause modifies the event denoted by the main clause and (b) *premise conditionals* in which the *if*-clause contributes a proposition which has to be taken as “the privileged context” for the processing of the apodosis (the latter has commonalities with Iatridou’s 1991 *factual conditionals*, *epistemic conditionals* in Sweetser 1990 and conditionals with *metarepresentational antecedents* in Noh 1996):

(1) *event conditional*: (Haegeman ibid)

If it rains we will all get terribly wet and miserable

(2) *premise conditional*:

If (as you say) it is going to rain, why don’t we just stay at home and watch a video?

She argues that the protasis in an event conditional provides a “cause” leading to the “effect” denoted by the content of the main clause. Premise conditionals, on the other hand, are usually “echoic” and have their own illocutionary force/anchoring to the speaker in contrast to event conditionals which are fully integrated in the syntactically encoded speech act of the main clause. She argues that this semantic difference between the two types of conditional has a syntactic basis. Although she characterises both types of protases as ‘subordinated’, in event conditionals the subordination is more evident and syntactically potent. Haegeman employs the separation of the sentence structure to the domain of the predicate, VP, the domain of modality/tense/mood etc., IP, and the domain of “the interface between the clause and its context”, CP. *If*-clauses in event conditionals are merged inside the VP/IP domain whereas premise-protases are located in the CP domain (therefore the two types exhibit distinct *external syntax*). Haegeman also assigns distinct internal syntactic articulation to each type of *if*-clause (their *internal syntax*). She employs a modified version of Rizzi’s (1997) mapping of

the CP domain into distinct phrases headed by functional elements encoding discourse-related and subordinating functions:

- (3) *The Split CP:*
 Sub(ordination) > Force > Top(ic)* > Foc(us) > Top(ic)* > Fin(itiness)

Event conditionals according to Haegeman are reduced clauses in that they lack the Force, Foc and Top heads while premise conditionals are intact in that they contain the same CP structure as main clauses (except subordination indicators). Her main evidence for these claims is as follows:

- a. Event conditional protases fall inside the scope of operators like tense, mood, negation, focus operators and quantificational adverbs in the main clause. For example, present tense inside an *if*-clause is interpreted as referring to a future time if the consequent has future tense.
- b. Premise conditionals have their own illocutionary force as opposed to event conditionals. Premise conditionals really encode two propositions with potentially distinct illocutionary forces.
- c. Main Clause phenomena (e.g. dislocation of arguments) only occur in sentences with a full CP, therefore, they do not occur in event conditional protases, whereas they occur in premise conditionals.
- d. Binding of pronouns in the protasis by a quantificational expression in the apodosis is only possible in event conditionals.
- e. (As a result), the semantic interpretation of the two types of clauses is distinct.

If true, the DS analysis presented earlier would not immediately accommodate these claims as we did not make any distinction between two types of conditionals. Therefore acceptance of Haegeman's evidence would lead us to consider an augmentation of the DS analysis to parallel hers. We will first examine the possibility of postulating two distinct structures to the propositional content generated by the processing of *if*-clauses (their "internal syntax") below.

1.a. An alternative DS analysis?

Within DS assumptions, Haegeman's observations regarding the distinct content provided by event and premise conditionals and their presumed distinct internal structure can be taken into account by assigning two distinct structural analyses to be provided by each type of string. Since DS is a lexicalised-procedural framework, the two distinct structures could be seen as resulting from two distinct sets of lexical actions associated with the word *if* (this would capture the distinct *internal syntax* of the two types). Notice that this means that the word *if* is ambiguous as between generating an event or premise interpretation. This can be further enriched by the assumption that each of the distinct sets of actions assigned to the lexical item *if* is executed according to whether the pointer appears on a LINK structure or an unfixed node (this would be intended to capture the distinct *external syntax* properties, we will discuss this further below). While the case of a protasis processed as a LINK structure can remain as already defined, embodying the analysis of premise conditionals, we could propose the following entry for the unfixed cases, implementing the analysis of event conditionals:

(4) *if*⁷⁴

- | | | |
|-------|-------------|---|
| (1). | IF | $?Ty(e_s), ?\exists x.Tn(x)$ |
| (2). | THEN | $put(?\exists x.(Fo(x) \wedge \langle L \rangle Fo(x)));$ |
| (3). | | $make(\langle L \rangle); go(\langle L \rangle); put(?Ty(e_s));$ |
| (4). | | $make(\langle \downarrow_1 \rangle); go(\langle \downarrow_1 \rangle); put(Ty(cn_s \rightarrow e_s), Fo(\lambda P.\tau, P)); go(\langle \uparrow_1 \rangle);$ |
| (5). | | $make(\langle \downarrow_0 \rangle); go(\langle \downarrow_0 \rangle); put(?Ty(cn_s))$ |
| (6). | | $make(\langle \downarrow_1 \rangle); put(?Ty((e_s \rightarrow t) \rightarrow cn_s);$ |
| (7). | | $make(\langle \downarrow_0 \rangle); go(\langle \downarrow_0 \rangle); put(Ty(e_s); freshput(\mathbf{s}, Fo(\mathbf{s})); go(\langle \uparrow_0 \rangle)$ |
| (8). | | $make(\langle \downarrow_1 \rangle); go(\langle \downarrow_1 \rangle); put(Ty(e_s \rightarrow ((e_s \rightarrow t) \rightarrow cn_s)); Fo(\lambda t.\lambda R. t, R(t));$ |
| (9). | | $go(\langle \uparrow_1 \rangle \langle \uparrow_1 \rangle); make(\langle \downarrow_0 \rangle); go(\langle \downarrow_0 \rangle); put(?Ty(e_s \rightarrow t))$ |
| (10). | ELSE | $abort$ |

⁷⁴ I am grateful to Ronnie Cann (pc.) for a suggestion of how to simplify this lexical entry.

the latter consideration later. As concerns empirical validity, there are reasons to think that, at least in English and similar languages, there is no syntactic evidence disambiguating the two interpretations identified by Haegeman. Therefore for the reasons that we will see immediately below it seems preferable to uniformly maintain the lexical entry presented in the previous chapter (although we are going to see that some inferentially derived interpretational differences can be accounted for by allowing the underspecified content provided by *if*-clauses to be incorporated at distinct points in a processing cycle).

1.a.1. Temporal subordination

Haegeman claims that in event conditionals the tense of the *if*-clause is subordinated to that of the main clause witness that, for example, a morphological present tense in the antecedent can be interpreted as referring to a future event. Notice that, even though Haegeman does not mention it, this is not a peculiarity arising solely with *if*-clauses. In the following relative clauses a present tense can be interpreted as referring to the future:

- (7) Every child who sees John will call his mother
- (8) Whoever sees John must call their mother

Haegeman explains this phenomenon in *if*-clauses as arising out of the subordination of the time indicators in the *if*-clause to the tense operator in the consequent, the latter indicated by the morphological future tense:

- (9) If your back-supporting muscles tire, you will be at increased risk of lower-back pain

In contrast, she claims, in premise conditionals like the following, future tense is interpreted independently of the consequent:

- (10) If I'm no longer going to be arrested for possessing cannabis ... shouldn't I be able to grow my own?

Although it might be true that there is a tense dependency between the antecedent and the consequent (as there could be in independent clauses too, see Partee 1984a) it is not necessary that *if*-clauses containing future tensed verbs should be necessarily characterised as bearing the properties

that Haegeman attributes to “premise conditionals”. The following attested examples show that the presence of future (*going to*) tense in the antecedent does not exclusively lead to an interpretation as a “premise conditional”:

- (11) AEDs are now used in GP surgeries and by ambulance services. An increasing amount of AEDs are becoming available in busy public places like airports, railway stations and shopping centres. If you are *going to* operate a defibrillator, you need to have had thorough and recent defibrillator training and appropriate training update sessions. You also need to know basic life support. The British Heart Foundation (BHF) encourages training in emergency life support skills and the wider use of defibrillators. <http://www.bhf.org.uk/questions/index.asp?secondlevel=1154&thirdlevel=1193> as retrieved on 4 Apr 2005 14:38:52 GMT.
- (12) Email and absence from Brookes (staff only):
If you are *going to be* away from Brookes, you can manage your email in three different ways:
1. You can set up an autoreply so anyone sending you an email gets a standard reply;
 2. You can forward mail to another email address;
 3. You can deal with it by using Webmail.
 4. Once you return to work you can turn off the autoreply feature.
- http://www.brookes.ac.uk/services/cs/email_issues/absence.html as retrieved on 23 Aug 2005 20:09:51 GMT.
- (13) Of course, if you *are going to* use functions, then you have to make sure that you load the definition of the function before you call it for use.
<http://www.injunea.demon.co.uk/pages/page207.htm> as retrieved on 16 Aug 2005 01:09:56 GMT.

There is no motivation in the above pieces of text to necessarily attribute an “echoic” or argumentative interpretation to the *if*-clause. In fact, as Edgington (2003) argues, there is no necessary correlation between a future interpretation of the present tense in the antecedent and a “causal” rather than a “premise” interpretation. All Haegeman’s event-conditional examples, given an adequate context, can be interpreted as premise-conditionals. Additionally, the purported tense dependency does not seem to arise in any other case except in the pattern: *if* + *present, future*. The tenses in the *if*-clauses of the following have their usual interpretations and their interpretation is not dependent on the consequent’s tense:

- (14) If they caught the noon train, they will arrive at two.
(past tense, past interpretation in the antecedent despite *will* in consequent)
- (15) If they caught the 10 a.m. train, they arrive/arrived/will have arrived at noon.
(past tense, past interpretation in the antecedent)

As for the phenomenon that Edgington terms the “tense oddity” of the interpretation of the present tense in the protasis of conditionals like the following:

(16) If they catch the two o'clock train, they will arrive at four

she points out that it is not specific to conditional contexts. The future tense has two functions which can be dissociated: besides referring to future time it also indicates ‘prediction’ or ‘inference’. For example, in the following, use of *will* does not refer to a future time but rather indicates an inferred conclusion or prediction regarding John’s whereabouts:

(17) John will be at home now

On the other hand the present tense can be used to indicate the future when an event is presented as completely certain:

(18) The sun sets at 7.03 tomorrow

According to Edgington, inside an *if*-clause a future tense would be interpreted as ‘prediction’ or ‘inference’ and therefore, in most cases, it contrasts with the ‘suppositional’ meaning of the protasis. In fact, Edgington argues that Haegeman’s characterisation of event conditionals as “causal” makes them too “factive”. In Edgington’s view, a conditional structure, of any type, involves an assertion of the consequent within the supposition expressed by the *if*-clause. The basis for this assertion within the scope of a supposition can be pragmatically enriched to any causal or inferential relation. From this point of view all conditionals can be characterised as “premise conditionals”.

1.a.2. Root transformations

Haegeman claims that, because of their structural deficiency, event conditionals do not tolerate phenomena that appear solely in main clauses e.g. *topicalisation* (the judgement below is Haegeman’s):

(19) *If these exams you don’t pass __ you won’t get a degree

This is because event conditionals lack some of the internal structure postulated for main clauses, i.e. they do not contain the projection of the heads *Foc(us)* and *Top(ic)* which are the syntactic positions hosting moved arguments. On the other hand, she claims that argument-fronting is (marginally) possible in adverbial clauses with root-like properties, i.e., premise conditionals:

- (20) If *these problems* we cannot solve __, there are many others that we can tackle immediately

It is not clear why (20) above should be necessarily construed as a “premise conditional”. As Edgington (2003) has shown we can always construct a context that will make any such conditional to be interpreted as “causal” and its syntactic form does not have to be changed. Moreover, as Shaer (2003) points out, there are parallel examples with dislocation occurring in what Haegeman would characterise as clearly “event conditionals”:

- (21) If *these books* you don't read __ you won't pass the exam!

Therefore it seems that this type of “root transformation” is possible after all in such clauses. An analysis which precluded utterances like the above as a matter of syntactic constraints would not make the correct predictions.

Moreover Hageman's analysis of a reduced CP for event conditionals is supposed to account for the fact that they are fully syntactically integrated clauses whereas premise conditionals are not. However, the V2 phenomenon, a sign of subordination in the Germanic languages which will be discussed below, does not seem to distinguish between premise and event conditionals either: on the one hand, V2 in general is impossible inside any type of *if*-clause (“internal syntax”); on the other hand, the two types of conditional postulated do not predict which kinds of protases can count as the first element for V2 (an issue of “external syntax”). Consider the following:

Afrikaans (modelled on an English example from Haegeman 2003)

- (22) As John in Rome bly, gebruik hy moontlik nooit sy fiets nie.
 if John in Rome lives uses he probably never his bike not
 If John lives in Rome, he probably never uses his bike.

Even though this is a “premise” conditional according to Haegeman, it is fully integrated in the main clause in that it counts as the first constituent for V2. Moreover, in the following the conditionals present “echoic” antecedents or consequents but full integration is still possible:

Afrikaans (modelled on English examples from Noh 1996)

- (23) A: Twee en elf maak dertig.
 two and eleven makes thirty
 B: As twee en elf dertig maak, het jou wiskunde meer werk nodig.
 if two and eleven thirty makes, has your maths more work necessary
 if two and eleven makes thirty your maths needs more work
- (24) Context: the phone is ringing and B is going to pick it up:
 A to B: As dit John is, ek is weg 'n uur gelede
 if it John is, I am away an hour ago
 As dit John is, is ek weg 'n uur gelede
 if it John is, am I away an hour ago
 If it's John, I've left an hour ago

It seems therefore there is no string related syntactic indication of the postulated semantic ambiguity (and in any case the existence of distinct semantic types is also in doubt as Edgington 2003 argues). Although the above are not necessarily counterexamples for Haegeman's analysis with the plethora of functional projections and features postulated, from the current perspective, the sparser logical form structure assumed by DS does not allow us to maintain any encoded syntactic distinction between premise and event conditionals. Consequently, considering all the syntactic evidence presented above, we have to reject the purported Haegeman-style DS analysis of *if* as inducing distinct propositional structures. For more arguments against Haegeman's view regarding the syntactic dichotomy between “event” and “premise” conditionals the reader is referred to Edgington (2003) and Shaer (2003). We now turn to the interpretational differences that are claimed to distinguish the two types and which Haegeman's analysis is designed to capture.

1.a.3. Interpretational evidence

While it seems that there are no evident syntactic differences that distinguish the two “types” of conditionals in English (apart from intonational clues which, we assume, are not discreetly encoded in the signal) it is true that different types of interpretations and inferential effects can be associated with *if*-clauses, effects roughly captured by each of the presumed types Haegeman postulates. It is widely accepted in the syntactic literature on conditionals that there is a distinction between what are called *Factual* and *Hypothetical Conditionals*. The latter type corresponds roughly to Haegeman’s category of event conditionals. Premise conditionals seem to have features of the category of other authors’ Factual Conditionals (Iatridou 1991, Bhatt & Pancheva 2001/2005, *metarepresentational conditionals* in Noh 1996). Additionally, another type of conditional has been distinguished in literature: the *relevance* or *speech act conditionals*, illustrated below:

(25) If you are thirsty, there is beer in the fridge.

According to Iatridou (1991), in Relevance Conditionals the antecedent is not used to single out the cases in which the proposition in the apodosis is claimed to hold. This is because that proposition is asserted to be true unconditionally. In those cases, instead, the antecedent is taken to specify the circumstances in which it is *relevant* to perform the speech act of informing the addressee of the truth of the proposition expressed by the consequent. It has been argued that in such structures there is an implicit performative verb in the main clause which explains the truth conditions. For the example in (25) above the underlying structure is claimed to be:

(26) If you are thirsty, then [*it is relevant for me to tell you that*] there is beer in the fridge.

Dancygier (1998), following Sweetser (1990) distinguishes between interpretations of conditionals in the *content*, the *epistemic* and the *speech-act* domains. The first type of interpretation roughly corresponds to event conditionals, the second to premise conditionals and the third to relevance conditionals. However, although Dancygier herself argues for a

“constructional approach” to the explication of the structure and meaning of conditionals she also presumes that the relation between the three domains is based on metaphorical transfer. This means that under the DS and RT assumptions made here, an appropriate pragmatic theory should be more suitable to derive the distinct types of interpretation associated with the processing of conditional structures in context without the semantic representation explicitly encoding every type of interpretation (which might very well be an open-ended number cf. Decklerk and Reed 2001). Nonetheless, one should note that the distinction between *relevance* and other conditionals, in contrast to the other distinctions that can be accounted for by purely pragmatic means (see e.g. Noh 1996), has some syntactic basis. In V2 languages like Afrikaans, according to the native speakers’ judgements it is impossible to sustain the same interpretation between the two conditionals below; this is because if the protasis appears as the first element before the verb as in (28) then it cannot be assigned a “relevance” interpretation (although it can be assigned a “factual”, metarepresentational or echoic interpretation, see (22)-(23) above):

- | | | |
|------|--|------------------|
| (27) | As jy my nodig het, ek is by die kantoor
if you me need has, I am at the office
If you need me I am at the office | <i>Afrikaans</i> |
| (28) | #As jy my nodig het, is ek by die kantoor
if you me need has, am I at the office
If you need me I am at the office | |

We will see whether we can capture this distinction below.

2. The DS Topic Analysis of *if*-clauses

Considerations of syntactic evidence led us to question the structural encoding of any rigid differentiation between types of conditionals based on the structure of the *if*-clause. For this reason we rejected the purported ambiguity-of-*if* DS analysis presented above. However, although there is no evidence for a structural ambiguity as regards the structure of the *if*-clause itself (in our terms the structure of the proposition derived by processing an *if*-

clause), there is evidence that conditional structures can be put to distinct uses. This is shown by the different interpretations for *if*-clauses identified in the literature. It is widely accepted that a sentence-initial *if*-clause somehow provides the context for the processing of the consequent. We can give formal substance to this intuition in two ways within DS. Without attributing any ambiguity to the encoded content of the *if*-clause itself, as with the processing of nominal phrases, we can assume that *if*-clauses too can be processed either as LINKed structures occupying independent subtrees or as providing content occupying structurally underspecified nodes. And it is not unreasonable to expect that, as is the case with free word order languages and dislocation phenomena in English, distinct parsing routes will be exploited for contextual effects facilitating one type of interpretation over another (see, e.g. the distinction between “focus” and “topic” interpretations postulated for English and other languages, Cann et al. 2005). Although evidence for such distinct parsing strategies for *if*-clauses is not readily available in English (apart from intonation), in languages with V2 we find two distinct ways of associating the *if*-clause with the apodosis. We will try to capture this type of evidence for two distinct ways of parsing *if*-clauses within an appropriate DS analysis below.

2.a. *If*-clauses and Nominals

The decision to analyse the antecedents of conditionals as contributing situation arguments leads us to expect that all the structural options available to the processing of nominals contributing terms are also available to the processing of conditionals. This conclusion is in line with Schlenker’s (2004) view regarding the fundamental symmetry that underlies linguistic reference in ontological domains like individuals, times and worlds despite the apparently variable syntactic means employed in individual languages. In the present context though this notion of symmetry will be assumed to hold at the level of the parsing procedures and LOT representations rather than in terms of surface-syntactic or external-semantic constructs. Terms of type *e* in DS can be processed by utilising two more strategies besides processing in the

usual argument positions: either as unfixed nodes initially in the parse or on their own individual subtrees which must be linked to another tree of type *t*. Below we discuss briefly these structures for the nominal domain (see Cann et al. 2005 for details).

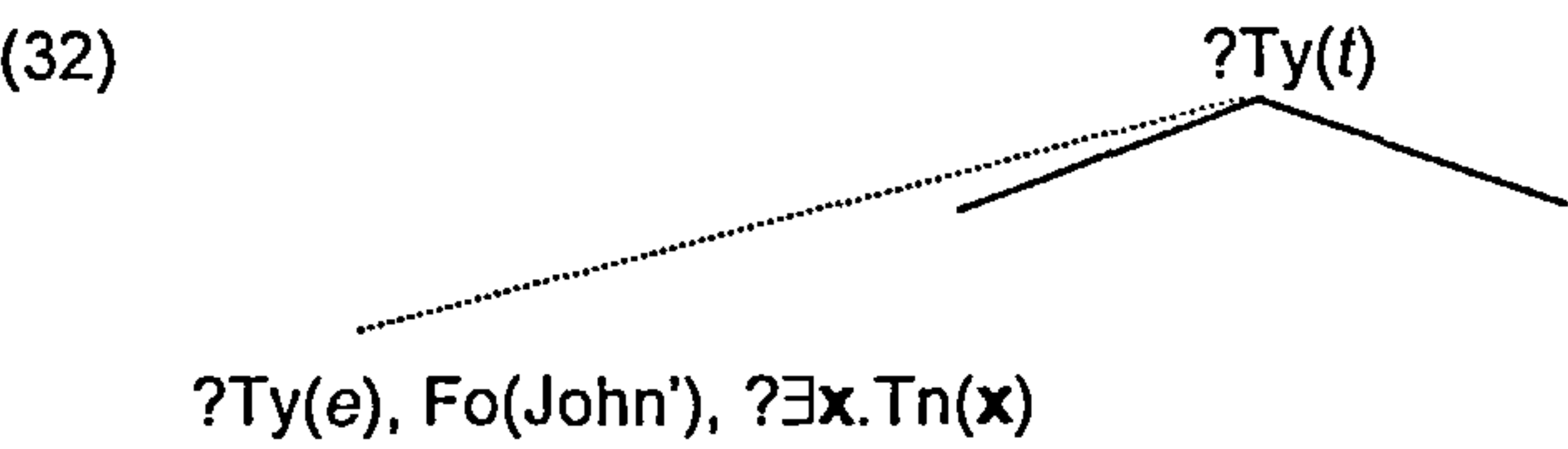
2.b. Left-Dislocation, Topicalisation, Hanging-Topic-Left Dislocation

In English the term *topicalisation* refers to the phenomenon of a left-peripheral DP associated with some position more deeply embedded in the following structure.

- (29) John Mary dislikes ____
- (30) John Mary said Bill dislikes ____.

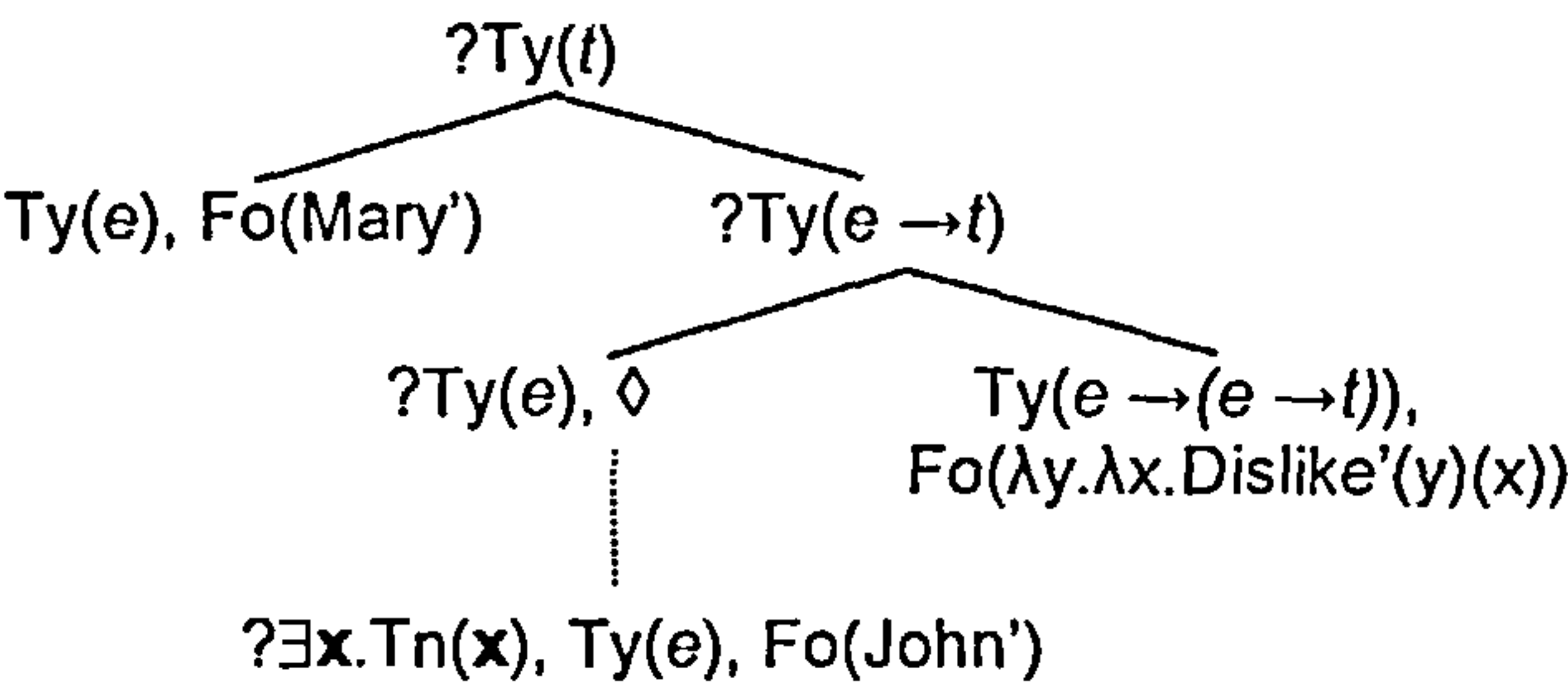
The fact that an argument position remains unoccupied as well as several *connectivity* effects like island-sensitivity indicate that the left dislocated phrase in these cases has to be construed as belonging to the following structure. In generative frameworks this is analysed as a *movement dependency*. In DS the rule of **Adjunction* allows for the initial processing of such left-dislocated DPs as unfixed nodes and the rule of Merge for their eventual incorporation in the tree:

(31)
$$\frac{*Adjunction \quad \{ \dots \{ \{ Tn(a), \dots ?Ty(t), \Diamond \} \} \dots \}}{\{ \dots \{ \{ Tn(a), \dots ?Ty(t) \} , \{ <\uparrow_*> Tn(a), ?\exists x.Tn(x), \dots, ?Ty(e), \Diamond \} \} \dots \}}$$



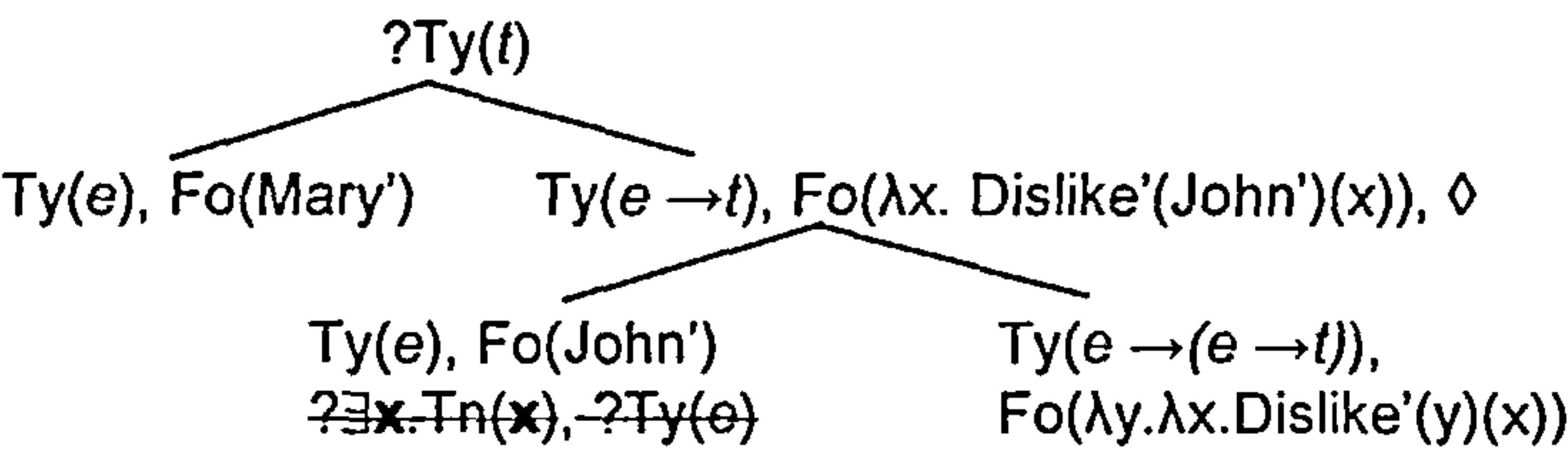
The tree constructed by this rule only temporarily records the fact that the dislocated DP was processed away from its eventual position since, after Merge, in the eventual structure, no record is retained of the initial structural underspecification:

(33)



Merge ⇒

(34)



The movement analyses of such constructions in the literature contrasts with constructions which involve (obligatory) anaphoric-like dependencies between left-dislocated phrases and an argument position inside the following structure:

(35)

That woman you dislike, I saw her leaving

(36)

(As for) John, I'll deal with him later

The standard diagnostics for such analyses cross-linguistically are the presence of a pronominal in the argument position and the lack of such connectivity effects as island sensitivity:

(37)

(As for) John, I'll deal with the man who insulted him later

DS analyses such structures by means of the construction of two independent subtrees nodes of which are connected with the LINK relation. Here there is only an obligatory anaphoric relation between the two trees and no merging of nodes. Processing of the left-dislocated phrase is achieved by the following *Topic Introduction Rule*:

(38)

Topic Structure Introduction Rule

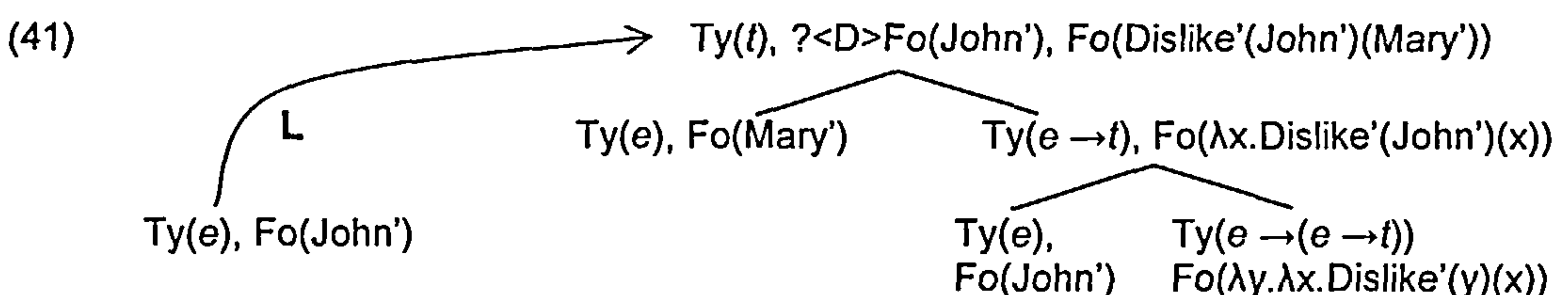
$$\frac{\{ \dots \{ \{ Tn(a), \dots ?Ty(t), \emptyset \} \} \dots \}}{\{ \dots \{ \{ Tn(a), \dots ?Ty(t) \}, \{ <L>Tn(a), ?Ty(e), \emptyset \} \} \dots \}}$$

From the *Axiom*, the rule allows for the building of a new node required to be of type e and moves the pointer there. The new node is linked to the main tree in a sense analogous to it providing the head of a relative clause. This means that the LINK relation originates from the newly constructed $?Ty(e)$ node which reconstructs the intuition that such peripheral constituents provide the context for the parsing of the following string. After processing of the left-peripheral element has been completed a specialised rule is employed to move the pointer to the $?Ty(t)$ node and simultaneously introduce a requirement that a copy of the Formula value appearing at the linked $Ty(e)$ node must be found in some subordinate position ($<D>$) in the main tree:

$$(39) \quad \frac{\text{Topic Structure Requirement Introduction Rule}}{\frac{\{ \dots \{ \{ Tn(a), \dots ?Ty(t) \}, \{ <L>Tn(a), Ty(e), Fo(a), \emptyset \} \} \dots \}}{\{ \dots \{ \{ Tn(a), \dots ?Ty(t), ?<D>Fo(a), \emptyset \}, \{ <L>Tn(a), Ty(e), Fo(a) \} \} \dots \}}}$$

For illustration consider the tree derived by the processing of such a string:

(40) (As for) *John*, Mary dislikes *him*



It can be seen that unlike what was the case with the processing of unfixed nodes, here the final representation retains a record of the partial independence of the left-dislocated phrase since the latter provides input that appears on its own separate tree. The main tree obligatorily contains a copy of the formula derived by processing the left dislocated phrase as a result of the modal requirement, $?<D>Fo(a)$, introduced by the *Topic Structure Requirement Introduction Rule*.

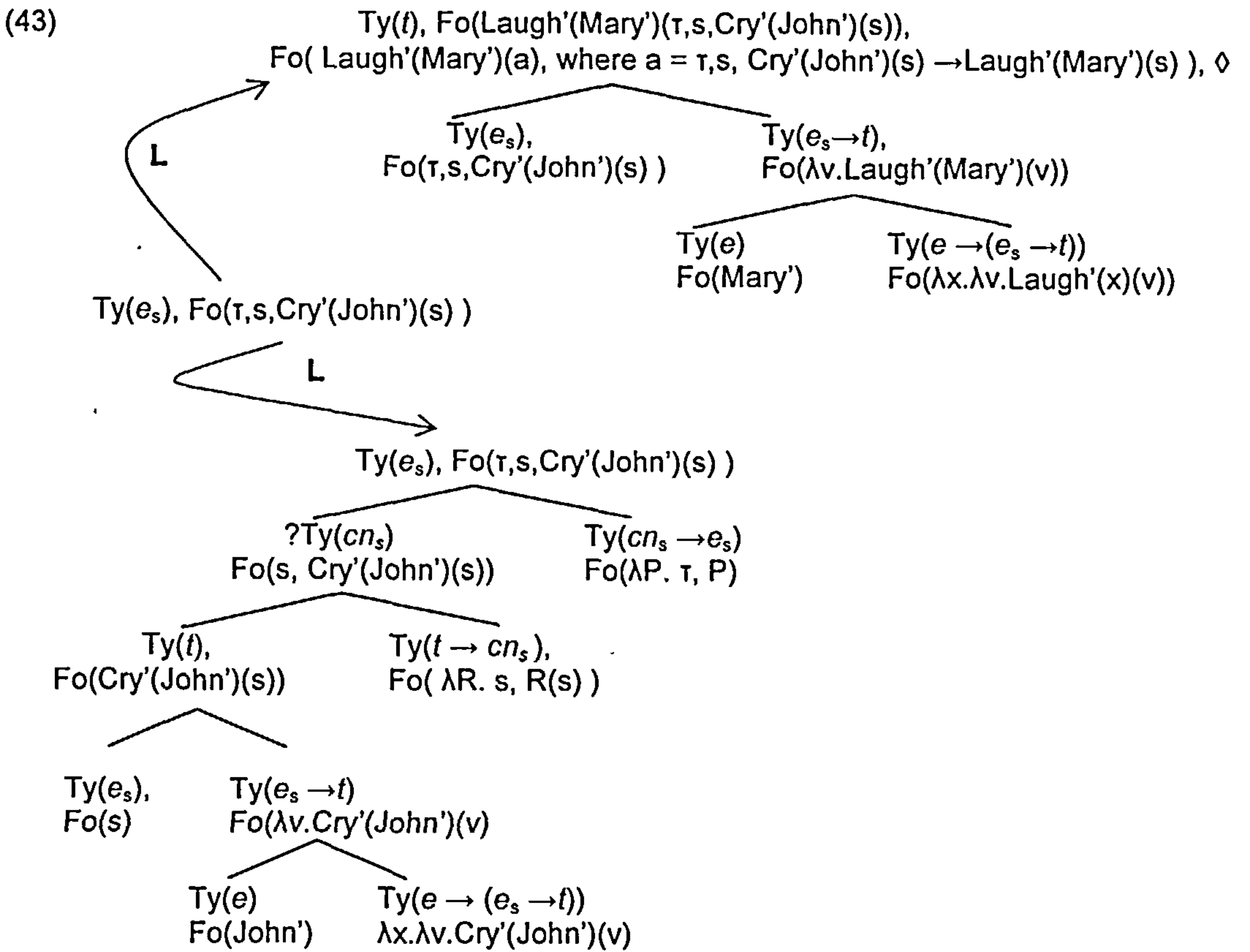
We saw in the previous chapter that we can use the rule of *Adjunction to account for many of the syntactic properties of *if*-clauses. We will now consider their processing as topic structures.

2.c. Topic structures and Conditionals

2.c.1. Clause-initial Link Introduction

Since the present analysis assumes that processing of the protasis results in the construction of a term of type *e* it is natural to assume that the above *Topic Introduction Rule* should be able to apply for the processing of *if*-clauses too. We can indeed assume that conditionals can be processed in two distinct ways. On the one hand, as it was shown earlier, the situation argument carrying the LINKed tree accommodating the content of the protasis might be processed as initially unfixed. This argument, whether processed sentence-initially or sentence-finally, will be required to Merge with the rest of the tree otherwise the structure will not be complete. On the other hand, there is another way for the content of the antecedent to be integrated in the tree representing the content of the consequent: a situation argument might be constructed independently and a requirement for its Formula value to appear inside the tree representing the consequent can be imposed. In that case, by anaphoric means, the situation argument of the tree representing the content of the apodosis will have the same Formula value as the top node of the LINKed subtree. An illustration of how such a tree would look like is below:

(42) If John cries Mary laughs



We now need to illustrate the processing strategy that will derive such structures.

2.d. Sample derivation of a conditional-topic structure

We start with the usual *Axiom*⁷⁵. The pointer appears at the root node with a requirement to derive a tree of type t :

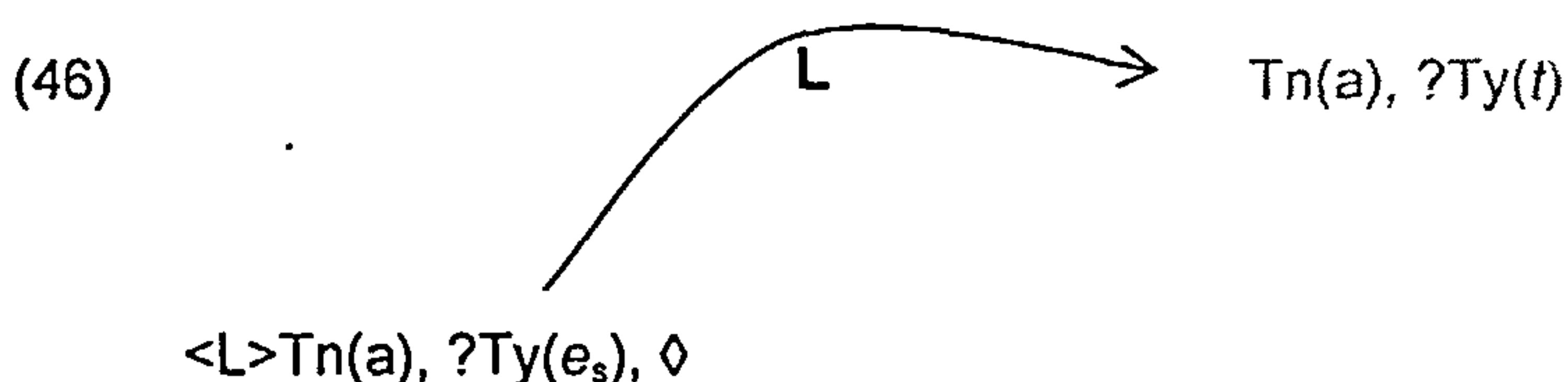
(44) $\text{Tn}(\text{a}), ?\text{Ty}(t), \diamond$

At this point the rule that constructs a node which will have the type t derived subtree LINKed to it can apply and create the LINK relation:

⁷⁵ We simplify illustrations here by omitting decorations that are not relevant.

$$(45) \quad \frac{\text{Topic Structure Introduction Rule} \quad \{ \dots \{ \{ \text{Tn}(a), \dots ?\text{Ty}(t), \diamond \} \} \dots \}}{\{ \dots \{ \{ \text{Tn}(a), \dots ?\text{Ty}(t) \}, \{ \langle L \rangle \text{Tn}(a), ?\text{Ty}(e_s), \diamond \} \} \dots \}}$$

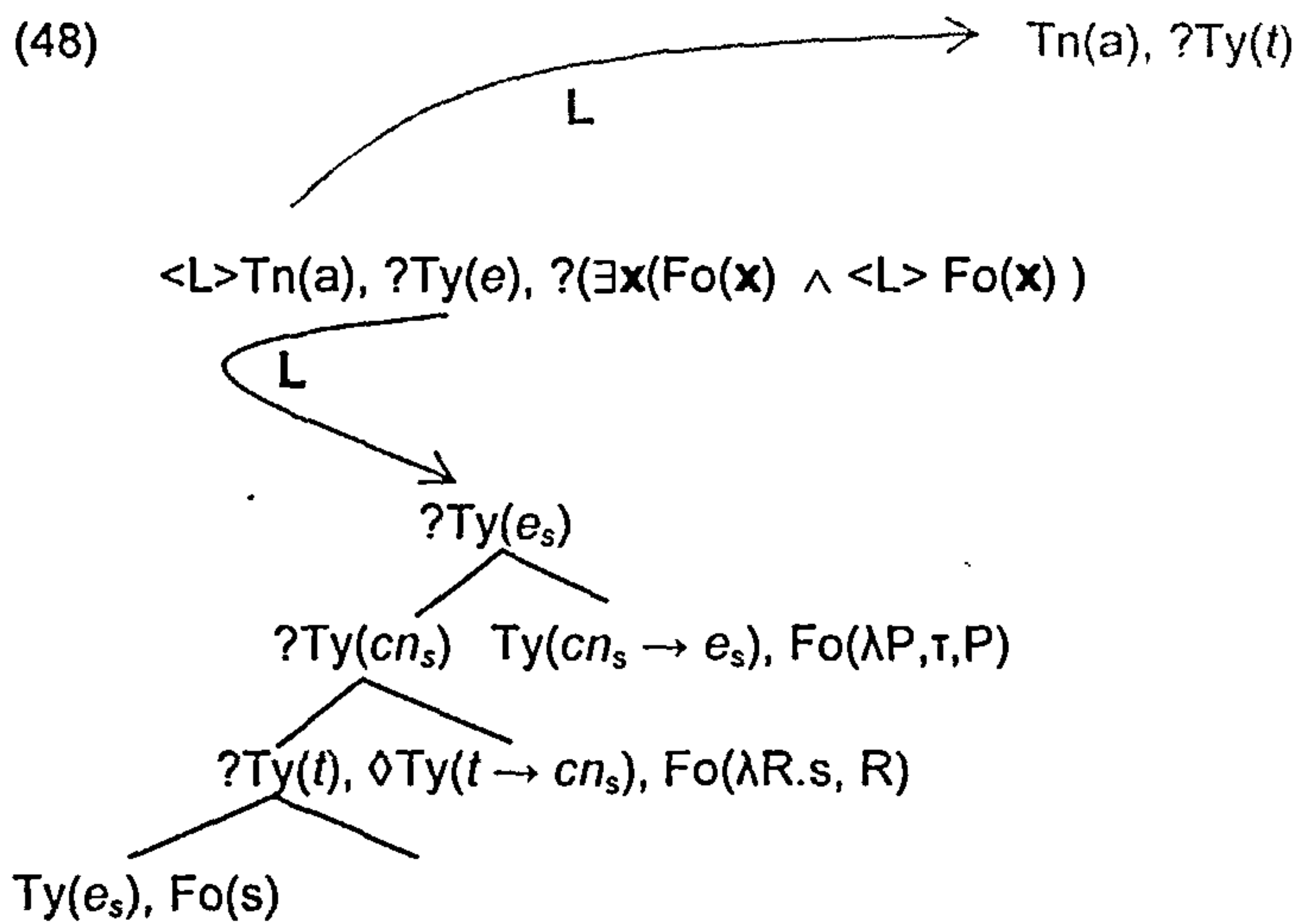
The rule transforms the *Axiom* as follows:



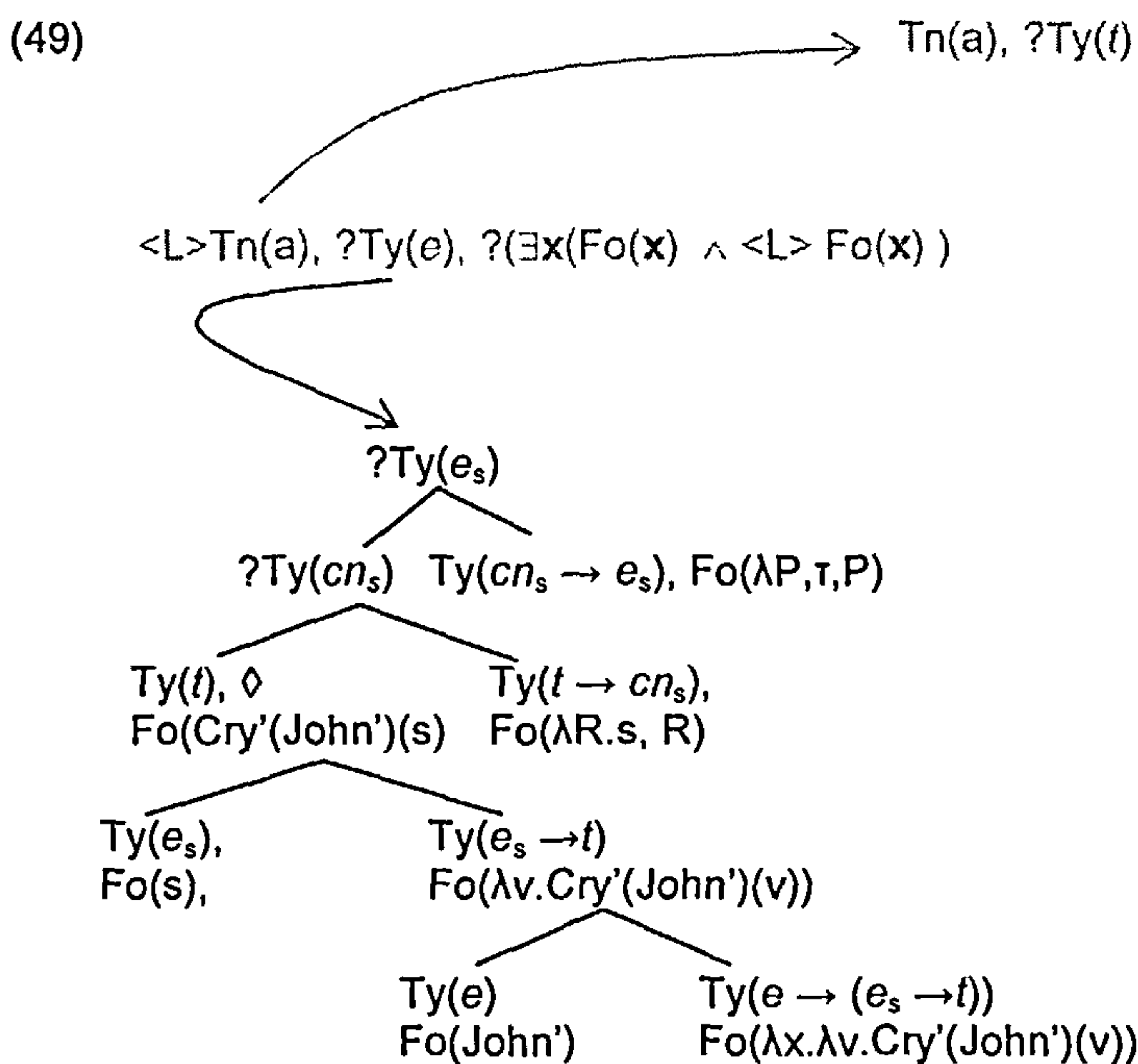
The pointer is now at a node with a requirement for a type e_s subtree. This is a context that matches the description in the condition for the rule associated with the lexical item *if*, given in the previous chapter, to apply. The rule is repeated below:

- (47) **if**
- (1). **IF** $?\text{Ty}(e_s)$
 - (2). **THEN** $\text{put}(?\exists \mathbf{x}.(\text{Fo}(\mathbf{x}) \wedge \langle L \rangle \text{Fo}(\mathbf{x})));$
 - (3). $\text{make}(\langle L \rangle); \text{go}(\langle L \rangle); \text{put}(?\text{Ty}(e_s));$
 - (4). $\text{make}(\langle \downarrow_1 \rangle); \text{go}(\langle \downarrow_1 \rangle); \text{put}(\text{Ty}(cn_s \rightarrow e_s), \text{Fo}(\lambda P. \tau, P)); \text{go}(\langle \uparrow_1 \rangle);$
 - (5). $\text{make}(\langle \downarrow_0 \rangle); \text{go}(\langle \downarrow_0 \rangle); \text{put}(?\text{Ty}(cn_s));$
 - (6). $\text{make}(\langle \downarrow_1 \rangle); \text{put}(\text{Ty}(t \rightarrow cn_s)), \text{freshput}(\mathbf{s}, \text{Fo}(\lambda R. \mathbf{s}, R)); \text{go}(\langle \uparrow_1 \rangle);$
 - (7). $\text{make}(\langle \downarrow_0 \rangle); \text{go}(\langle \downarrow_0 \rangle); \text{put}(?\text{Ty}(t));$
 - (8). $\text{make}(\langle \downarrow_0 \rangle); \text{go}(\langle \downarrow_0 \rangle); \text{put}(\text{Ty}(e_s); \text{Fo}(\mathbf{s}); \text{go}(\langle \uparrow_0 \rangle)$
 - (9). **ELSE** abort

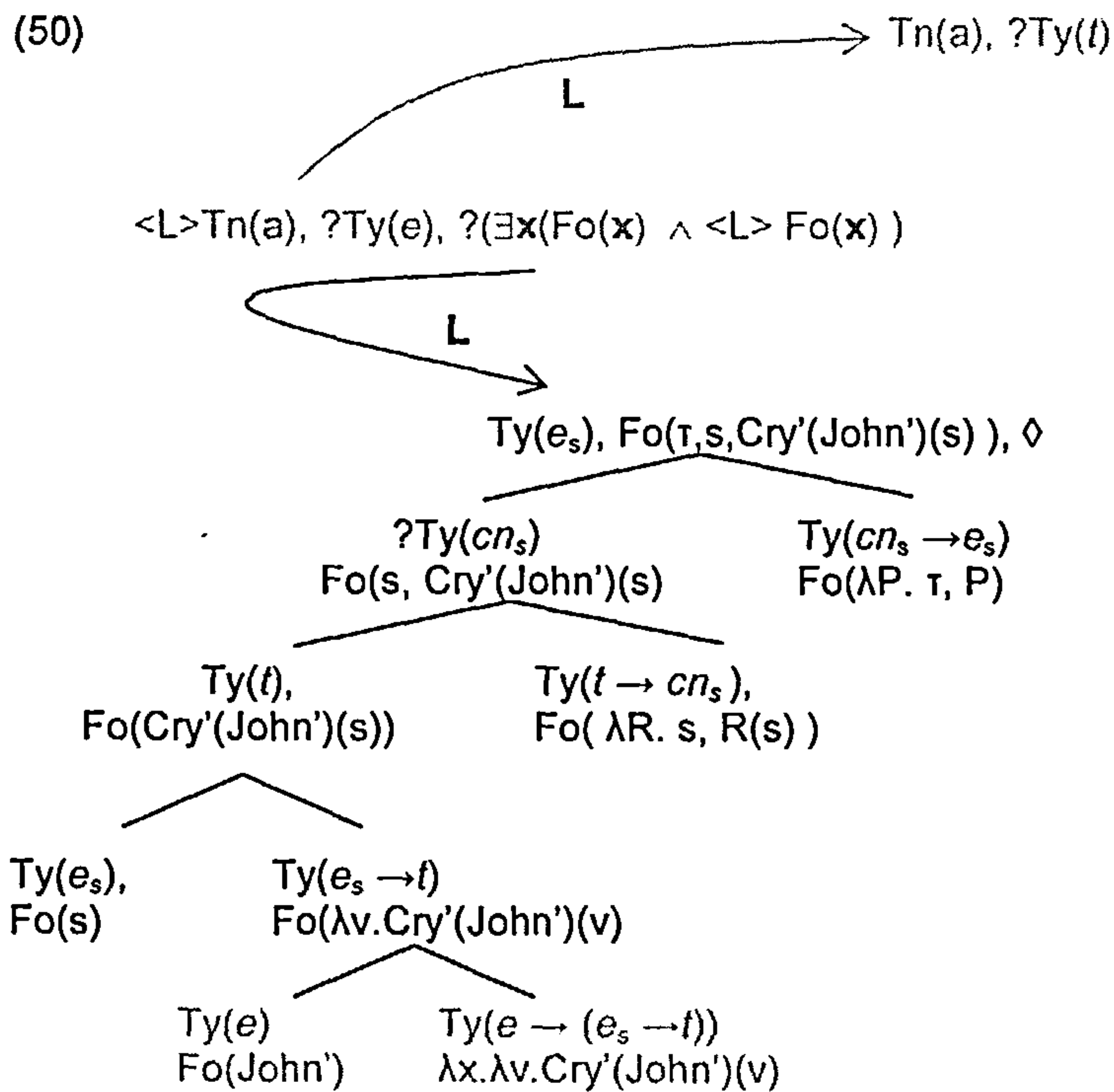
By the actions included in the lexical entry for *if* another LINK relation is initiated this time originating from the $?\text{Ty}(e_s)$ node. A partial structure is built and a new $?\text{Ty}(t)$ tree is introduced. Its situation node is a fresh variable s which also appears ready to be bound inside the Formula value of the type $(t \rightarrow cn_s)$ which will derive the restrictor for the τ -term to be constructed out of processing the protasis. The following depicts the effect application of the above has on the tree in (46):



The usual parsing processes can now take over and construct the propositional tree derived by parsing the antecedent string: *(if) John cries*. The output of these processes is shown below:



This structure can now be completed by the usual Completion and Evaluation processes to derive a tau term over situations at the top node of the lowest LINKed tree:



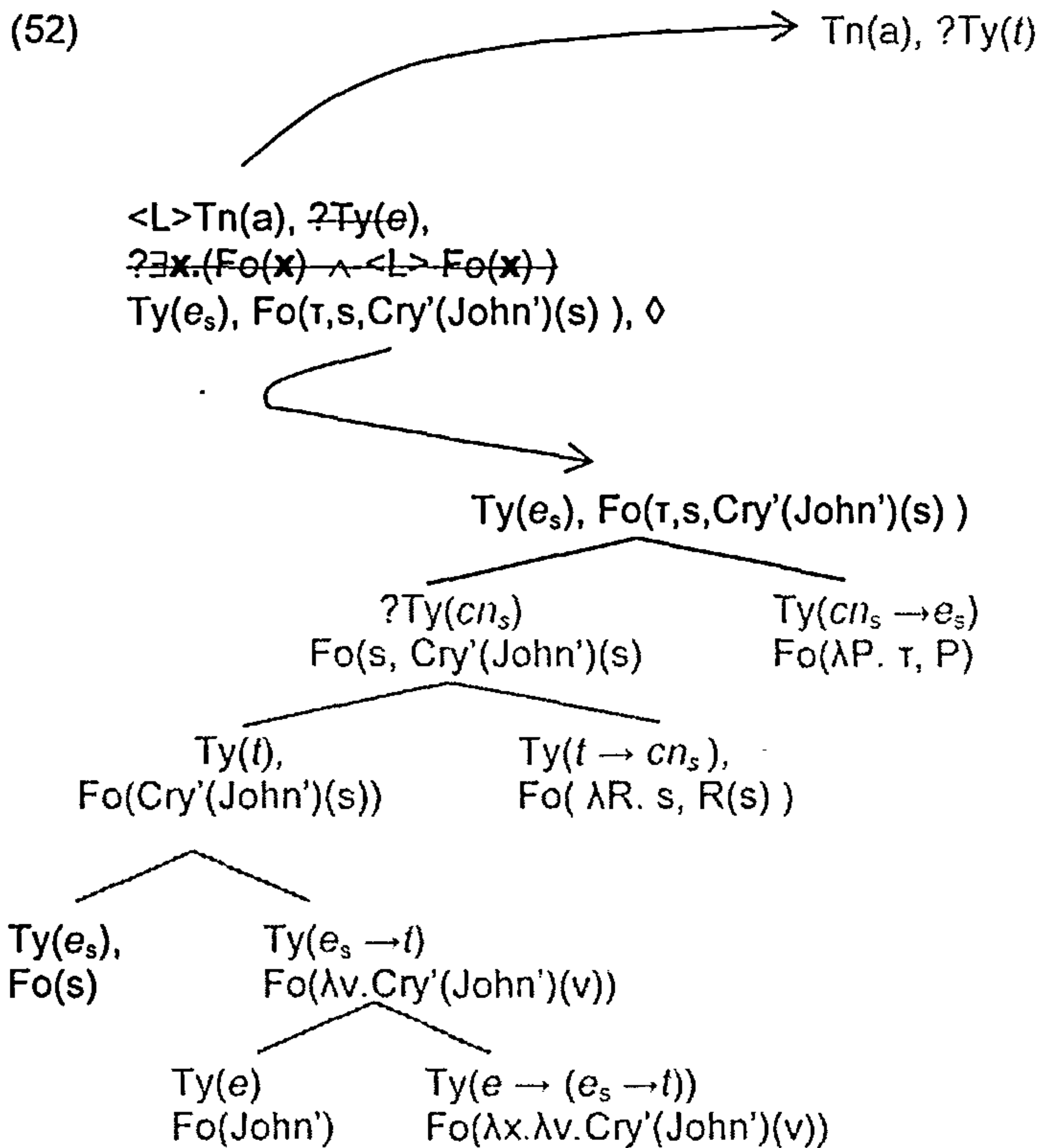
Now the *Link Evaluation Rule* for conditionals can copy the formula value from the node where the pointer is located to the node from which the first LINK relation originates:

(51) **LINK Evaluation Rule: Conditionals:**

{ { Tn(X), Ty(t), ... },
 { $\langle \uparrow_0 \rangle Tn(X), ?Ty(e_s), ?\exists x.Fo(x) \dots$ }, { $\langle L^1 \rangle \langle \uparrow_0 \rangle Tn(X), Ty(e_s) Fo(a_{[x]}), \dots, \diamond$ } ... } }

{ { Tn(X), Ty(t), ..., Scope(**U** $\langle x \rangle$) },
 { $\langle \uparrow_0 \rangle Tn(X), ?Ty(e_s), ?\exists x.Fo(x) \dots, ?Sc(x), Fo(a_{[x]}), \diamond$ }, { $\langle L^1 \rangle \langle \uparrow_0 \rangle Tn(X), Ty(e_s) Fo(a_{[x]}), \dots$ } ... } }

The tree derived is now as follows (scope details are omitted at present):

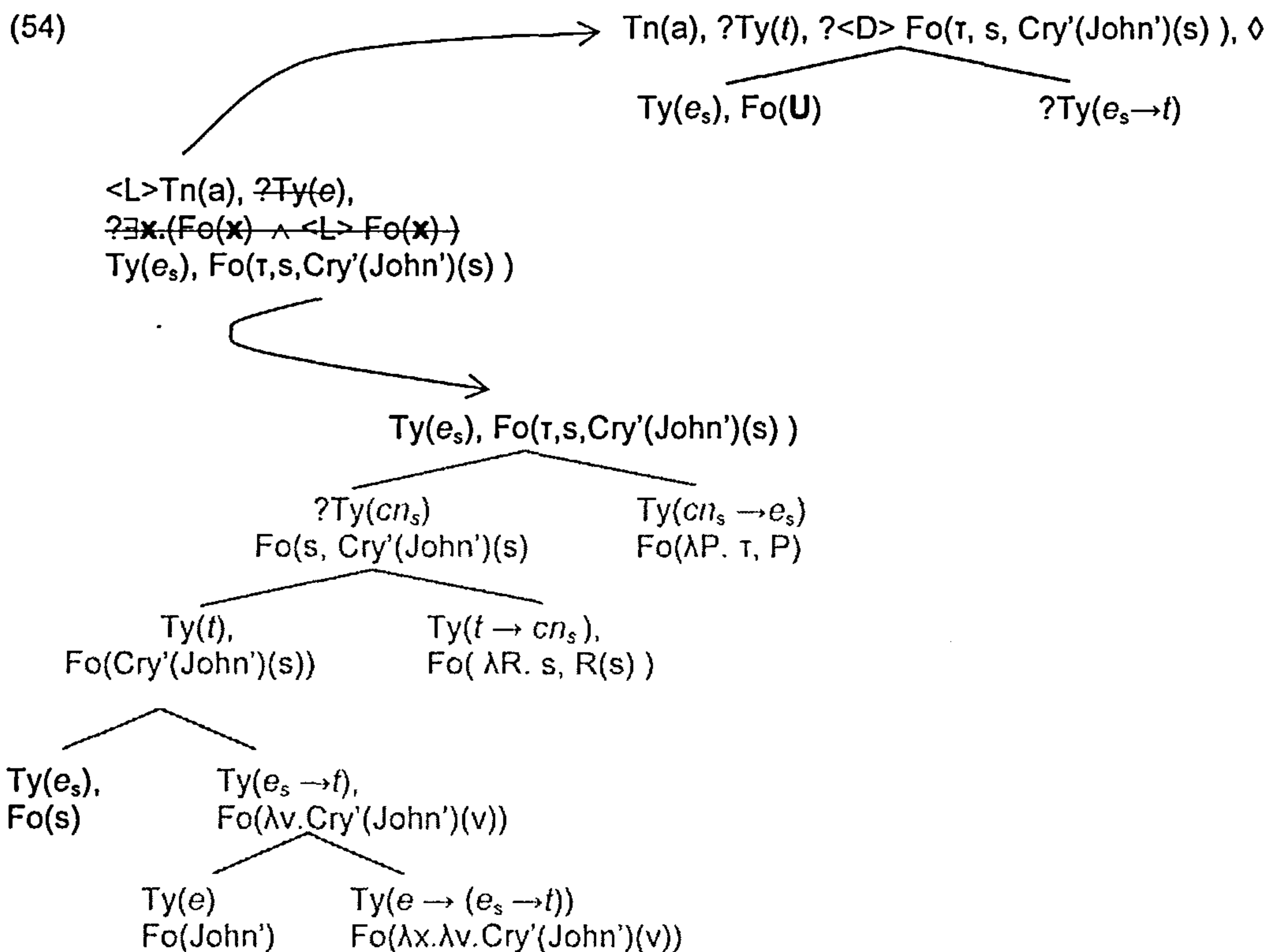


We now need to be able to move back to the propositional tree that will accommodate the content derived by processing the apodosis. The *Topic Structure Requirement Rule* can now apply in order to introduce a requirement that the term derived from the *if*-clause must appear somewhere inside the structure derived from the apodosis. The pointer will also move to the original type t tree from where we started the processing (note that this rule is able to apply in this case because we have assumed that $Ty(e)$ is now a general type label encompassing both terms ranging over individuals and terms over situations):

(53) **Topic Structure Requirement Introduction Rule**

$$\frac{\{ \dots \{ \{ Tn(a), \dots ?Ty(t) \}, \{ \langle L \rangle Tn(a), Ty(e), Fo(a), \emptyset \} \} \dots \}}{\{ \dots \{ \{ Tn(a), \dots ?Ty(t), ?\langle D \rangle Fo(a), \emptyset \}, \{ \langle L \rangle Tn(a), Ty(e), Fo(a) \} \} \dots \}}$$

The output of the rule after application to the tree above is as follows:



If we take the above as a representation of the content of a sentence like *if John cries, Mary laughs* then the situation metavariable of the highest propositional tree must be replaced with the τ -term derived on the LINKed nodes otherwise the requirement $?<D>Fo(\tau, s, Cry'(John')(s))$ will not be satisfied. Another alternative is illustrated by cases where the situation argument constructed out of the protasis is associated with an embedded clause:

(55) If John cries Mary heard Sue laughs.

A possible interpretation for the above could be that “Mary heard that in all situations where John cries Sue laughs”. This interpretation is captured by allowing the situation argument for the embedded proposition to be replaced by the τ -term derived from the protasis. Another possible (although admittedly slightly more difficult) permitted association of the situation argument with a proposition would be the following:

(56) If John cries, Mary knows a woman who would reassure him

This could be given the interpretation “Mary knows a woman who in all situations in which John cries will reassure him”. This association of the situation argument is predicted to exist because of the modality $\langle D \rangle$ employed in the requirement introduced by the *Topic Structure Requirement Introduction Rule*. This modality allows the requirement to be satisfied even if the situation argument appears inside the proposition derived from a relative clause. We will allow this association here. However, if the above interpretation seems to be excluded we will just have to have a separate, more restrictive, *Topic Structure Requirement Introduction Rule* for situation arguments. Alternatively we could assume that the connection between the situation argument appearing on the LINKed type e node and the content of the relative clause in the above is captured by means of the anaphoricity of the modal *would* and similar operators (see e.g. Stone 1997). In that case we will have to modify the requirement introduced by the *Topic Structure Requirement Introduction Rule* to allow that the term is not necessarily located at an argument node but is generally part of the formula derived. In this case we will notate the requirement $? \langle D \rangle \text{Fo}(a)$ as $? \langle D \rangle \text{Fo}(\varphi[a])$. We will leave the choice among these options open.

The processing of *if*-clauses as contributing content appearing on LINKed nodes allows us to account for certain phenomena that we were unable to handle previously. Firstly there are theory-internal technical reasons for requiring two strategies of processing sentence-initial *if*-clauses. Since only one unfixed node introduced by **Adjunction* is allowed per structure, the following would not be able to be processed unless we assume that the *if*-clause occupies a LINKed tree:

(57) If John comes, who will Mary fire?

But there are also other reasons for such as a second strategy to be available. We examine those briefly below.

2.e. Pronominalisation of the *if*-clause by *it*

According to Emonds (1985), *if/when*-clauses seem to be the only adverbial subordinate clause which can serve as the antecedent for the anaphoric impersonal argument *it* of certain verbs. In this, according to Emonds, they are parallel to the right and left dislocated NPs in (59) studied by Ross (1967)⁷⁶:

(58) [If John sings arias]_i it_i bothers me/ I dislike it_i a lot/I don't talk about it_i to anyone

(59) Those arias_i, they_i bother me/I dislike them_i/I don't talk about them_i to anyone

(60) *[Although/Because/After John sings arias]_i it_i bothers me/I dislike it_i a lot/I don't talk about it_i to anyone

However, notice that *if*-clauses cannot be themselves the subject of such verbs:

(61) *If you did that bothers me.

(62) *If you did that would be nice.

(63) If you did that it would be nice.

(64) It would be nice if you did that.

(65) For you to do that would be nice.

Under the present analysis, processing of the *if*-clause contributes a τ -term of type e_s in the representation which stands for the set of situations indicated by the content of the *if*-clause. To account for the impossibility of (61) we can assume that verbs like *bother* require an argument of type e_i the type of individuals, which is a more specific subtype of type e (cf. 'John bothers me a lot')⁷⁷. Therefore an argument of type e_s , the type of argument derived from the *if*-clause, is not directly a suitable argument in such cases, therefore a process of Merge is necessarily excluded. On the other hand, since the lexical item *it* is anaphoric and therefore contributes a metavariable in the

⁷⁶ If this parallel is accurate, then it is more directly reflected in Schlenker's (2001) analysis of conditionals as (plural) definite descriptions of worlds or Schein's (2001) analysis of *if*-clauses as (plural) definite descriptions of events. Since definites in DS are analysed as anaphoric (or sometimes cataphoric) elements this type of analysis is not available for us here. We will provide data later that show that τ -terms, similarly to definites, are not excluded from appearing on LINKed structures.

⁷⁷ Such verbs are also compatible with type t subjects. We can either allow that as a separate option (see Cann et. al. 2005) or utilise the *epsilon* term derived, according to the present analysis, from type t structures (analysed as LINKed to the term) to provide the replacement for the metavariable contributed by *it* (for the appropriate rules see Gregoromichelaki 2003).

representation we can assume that it can pick up a Formula value available in a local LINKed structure which by some process of “coercion” (not modelled here) is assigned the type appropriate for the argument of such verbs. Since the requirement introduced by the *Topic Requirement Introduction Rule* only requires the Formula value (and not the type) to appear somewhere in the main tree the requirement will be satisfied in such cases.

2.f. Correlatives and *then*

It has been observed by many researchers that in many languages *if*-clauses and nominal relative clauses have the same structure and even utilize the same lexical devices. The following data comes from Bhatt & Pancheva (2001):

- Marathi*
- (66) (dzar) tyane abhyas kela tar to pa hoýl
 if he studying do-Pst.3MSg then he pass be-Fut.3S
 If he studies, he will pass (the exam).
- (67) dzo manus tudzhya' sedzarý rahto to manus lekhak ahe
 which man your neighborhood-in live-Prs.3MSg that man writer is
 The man who lives in your neighborhood is a writer.
 (Lit. 'Which man lives in your neighborhood, that man is a writer.')

Additionally in many languages the interpretation of structures is ambiguous between a reading that involves sharing of an individual term or a term ranging over worlds/times/situations. Below the correlative clause which contains the complementiser *kaji*, introduces a term which is resumed in the following main clause by the demonstrative pronoun *ngula-ju*. On the first reading (A) the term picked up is an individual, a dog, whereas on reading (B), a possible situation (or set of situations, for discussion see Bittner 2001):

- (68) *Warlpiri (from Hale 1976)*
- | | | | |
|------------|--------------|------------|--------------|
| Maliki-rli | kaji-ngki | yarlki-rni | nyuntu |
| dog-ERG | COMP-3SG.2SG | bite-NPST | you |
| ngula-ju | kapi-rna | luwa-rni | ngajulu-rlu. |
| DEM-TOP | FUT-1SG.3SG | shoot-NPST | me-ERG |

A. 'As for *the* dog that bites you, I'll shoot *it*.'

B. 'If a dog bites you, *then* I'll shoot it.'

For English, Geis (1985) and others since then have pointed out that the lexical item *then* can be characterized as a resumptive pronoun and the structure *if p then q* as a correlative structure (see also von Stechow 1994). In the present approach, concurring with such analyses, we can take the lexical item *then* appearing in conditionals as contributing a meta-variable in the representation. This metavariable decorates the situation argument of the main tree and it can be seen as a lexical instantiation of the *Situation Metavariable Introduction* rule seen in the previous chapter. The proposed lexical entry would be as follows:

(69) **then**

 IF ?Ty(e_s)

 THEN put(Ty(e_s), Fo(**S**), [\downarrow] \perp); go(< \uparrow_o >)

 ELSE abort

Application of these instructions will then prevent the processing of an *if*-clause as an unfixed node because the condition in the lexical entry for *if* requires the presence of the pointer at a ?Ty(e_s) node. Additionally the bottom restriction ([\downarrow] \perp) in the lexical entry will exclude Late *Adjunction too. Therefore the only option for processing an *if p then q* sentence will be as a LINK structure where the *if*-clause contributes its content to a subtree separate from the main tree hosting the content of the consequent. This accounts for the necessary preverbal presence of the *if*-clause in such structures:

(70) *Then I will leave if Mary comes

An alternative to the bottom restriction to account for the ungrammaticality of the above would be to take it as arising from the constraints on Substitution that exclude the following:

(71) *He_i saw John_i

In this case we will be able to maintain an analysis for *if-then* structures as also involving unfixed situation arguments. In that case, the analysis would be modelling the bleaching effect usually associated with expletive pronouns (see Cann et al. 2005). We will leave both options open here. Moreover, as with all pronominals in DS, the replacement for the metavariable inserted by *then* can be provided by a term available in the Discourse Context. If an *if*-clause is not used to provide such a replacement other types of linguistic or non-linguistic means can provide it:

(72) A: Mary will come.

(73) B: *Then* I will leave.

2.g. Recapitulation

Dancygier & Sweetser (2005: 174) observe that *if*-clauses (P-clauses in their terminology) appear in the following formal patterns (excluding parenthetical uses) which they assume contrast in terms of interpretations:

- (74) if P, Q: If the home computer breaks down, I'll work in my office.
- (75) If P Q: If the home computer breaks down I'll work in my office.
- (76) Q if P: I'll work in my office if the home computer breaks down.
- (77) Q, if P: I'll work in my office, if the home computer breaks down.

We have now provided an analysis that could underlie the intuitions discriminating the first three patterns. Although we do not agree that there is an strict, encoded form-function mapping especially relying on intonational phrasing which is known to be susceptible to a multitude of factors besides indication of inferential and structural aspects of interpretation, we can provide a formal basis for the intuition that the fourth pattern can be used to indicate that the Q-clause relies on prior contextual justification for its introduction: "The Q-clause is then followed (after a comma/pause) by P, which either further restricts the context in which the assertion of Q is valid, or justifies the communication of Q as appropriate (this may involve conditions on speech acts and metalinguistic conditions)" (Dancygier & Sweetser *ibid*:

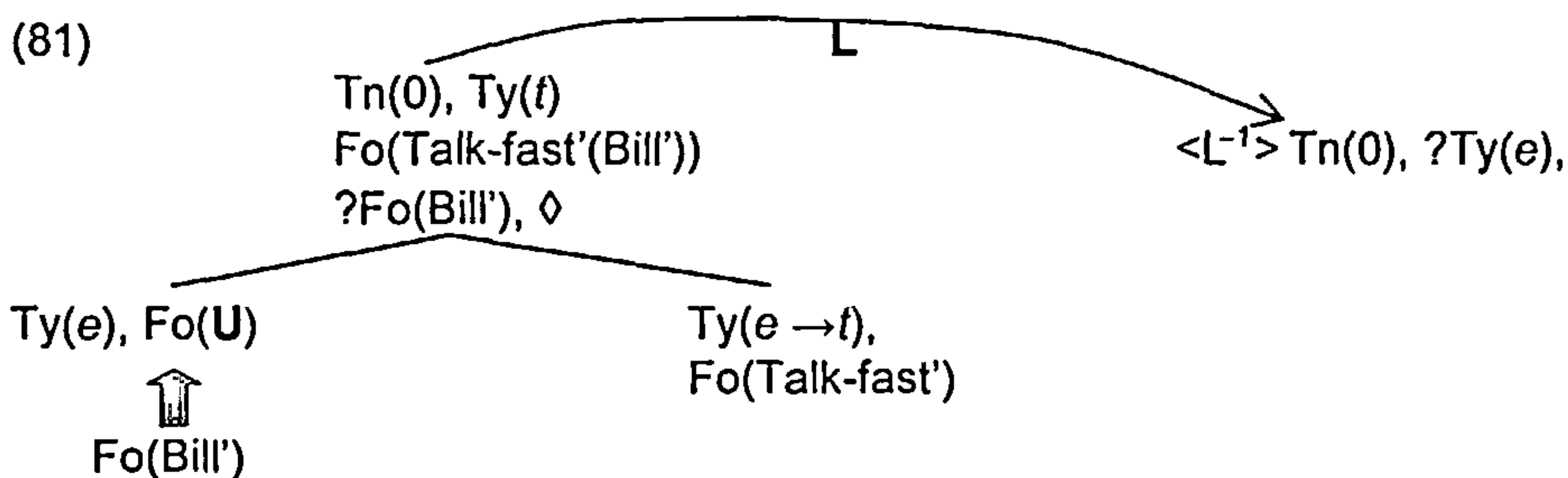
175). In DS a similar pattern as regards nominals has been identified (Cann et al 2005, Ch. 5):

- (78) She's a fool, my mother
 (79) He talks too fast, Bill

A right peripheral nominal expression can be presented with an anaphoric expression inside the main clause necessarily identified as co-referential with it. The right peripheral expression is necessarily optional and definite. The DS rule that handles this pattern is the rule of *Recapitulation*:

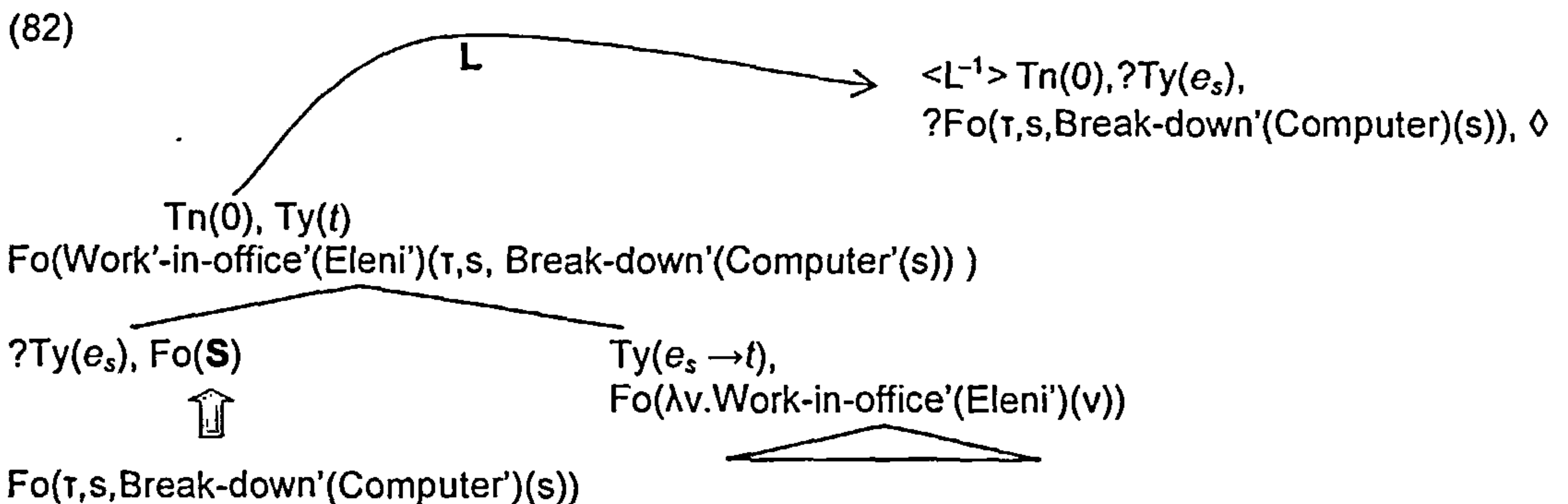
$$(80) \quad \frac{\text{Recapitulation} \quad \{ \dots, \{ \text{Tn}(0), \dots, \text{Ty}(t), \text{Fo}(\varphi), \dots, \{ \uparrow \star \text{Tn}(0), \text{Tn}(n), \text{Ty}(e), \text{Fo}(a) \}, \dots, \diamond \} \dots \}}{\{ \dots, \{ \text{Tn}(0), \dots, \text{Ty}(t), \text{Fo}(\varphi), \dots, \{ \uparrow \star \text{Tn}(0), \text{Tn}(n), \text{Ty}(e), \text{Fo}(a) \}, \dots \} \dots \}, \{ \langle L^{-1} \rangle \text{Tn}(0), ?\text{Ty}(e), ?\text{Fo}(a), \diamond \}}$$

Following the completion of a propositional type t structure, the rule initiates a LINKed tree which bears the requirement to include a formula value identical to one appearing inside the tree from which the LINK relation originates. Since the latter has necessarily been completed prior to the application of the rule, the formula value that needs to be copied must have been provided contextually if it was introduced by a pronominal expression. As an illustration consider the (schematic) tree that will be derived for the string in (79) (where the bold arrow indicates Substitution of a metavariable formula value on a treenode by a contextually provided value):

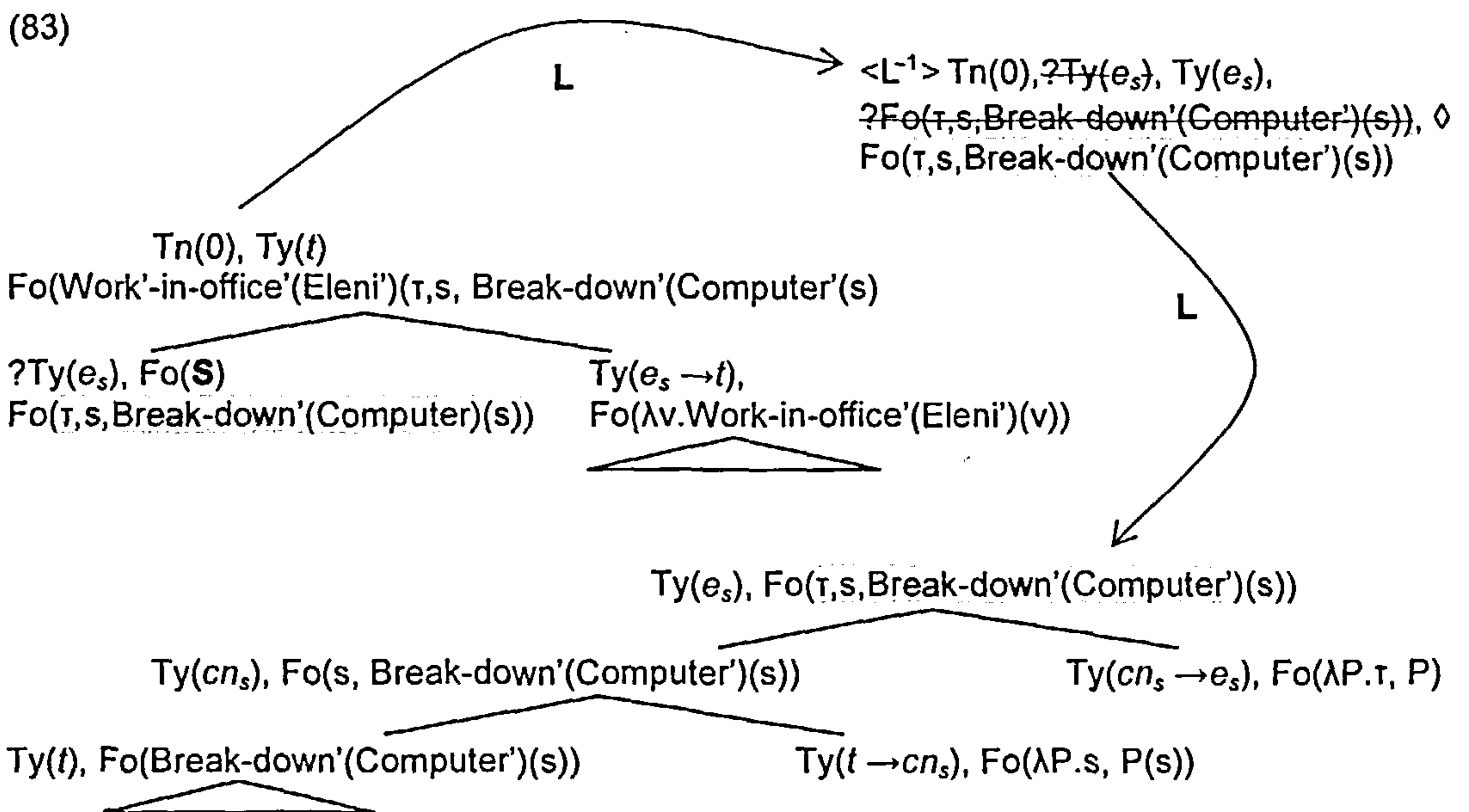


We can give a parallel analysis for the pattern in (77). The right peripheral *if*-clause can provide justification for the selection of the contextually derived situation term by the hearer or further restrict it by means of providing additional clues for the value of the metavariable R , the contextual restriction

always included in such terms (see Chapter 5: 4.b.1). As an illustration consider the tree derived from the Q-clause in (77) just before parsing the of the P-clause and after application of the Recapitulation rule (now taking the type e mentioned in the previous rule as the general supertype):



The above illustrates the contextual provision of a value for the metavariable at the situation argument node and the requirement for it to appear again in the new ?Ty(e_s) tree initiated. Parsing of the *if*-clause can then provide the required value. After processing of the P-clause has been finalised the (schematic) structure that ensues for (77) above is as follows:



2.h. Linear Order and Context-building

With the introduction of LINK analyses we now have two general ways of processing the input provided by *if*-clauses: either as attached to an unfixed node which merges with the situation argument of the main structure or as attached to a situation argument related by LINK to the main tree. This assumption will lead us to expect an ambiguity as regards the processing of a conditional structure since there is no necessary anaphoric element appearing in the consequent and disambiguating which structure is intended (especially in cases where there is no *then*). This attributed ambiguity to strings might seem an artefact of the analytic choices made here but, as we will now see, receives support from cross-linguistic and information structure considerations.

Firstly, it must be noted that, according to the analyses presented here, the linear order of *if*-clause and consequent does not disambiguate among the LINK or unfixed node structural options. We believe that this is as it should be because linear order, or order of processing in our terms, is not the only factor that determines the status of the *if*-clause. According to Geis (1985), although logicians and philosophers normally cite conditional sentences with preposed protases, syntacticians are likely to take a conditional with a postverbal antecedent to be “more natural” because in such structures the *if*-clause occurs in the “normal” adverbial position. He states moreover that not all languages have even the capacity to place the antecedent clause in sentence-initial position. This contradicts Greenberg (1963, cited in Bhatt & Pancheva 2005) who provides the following universal concerning the linear order between protasis and apodosis:

(84) *Universal of Word Order 14*: In conditional statements, the conditional clause precedes the conclusion as the normal order in all languages.

Comrie (1986) claims that there are also rigidly verb-final languages where the possibility of a protasis occurring clause-finally is not available. Bhatt & Pancheva (2001) state that they have not been able to verify this claim and

that in fact, Turkish, which is one of the languages that Comrie cites, seems to allow clause-final antecedents. In terms of the relative frequency of occurrence of clause-final and clause-initial conditional antecedents the evidence is also non-conclusive. Corpus studies reported in Dancygier (1998)⁷⁸ have found a preponderance of clause-initial *if*-clauses. On the other hand, Renmans & van Belle (2003) report almost equal distribution of preposed and postposed protases in Dutch (even though the study included constructions including *then*). Auer (2000) reports that corpus studies regarding written discourse in German shows an overwhelming preference for “postpositioning” of *wenn*-clauses⁷⁹. From the present perspective, this shows that when conditional structures are marked as such (i.e. in contrast to coordinate structures with conditional interpretations), order of presentation can be employed for information structuring purposes and the structures can be disambiguated only in conjunction with the context of utterance. We can make a parallel here with the case of argument pro-drop languages. In such languages when an overt NP providing an argument that could have been dropped appears on the string it usually enjoys relative positional freedom. This is because, according to the DS analysis, such phrases have to be analysed as decorating an unfixed node or LINK structure since there is no need for overt provision of such an argument in case the context of utterance can contribute a substitution for the metavariable introduced by the verb; so the provision of this overt argument can be employed for various information structural purposes, hence the positional freedom. In the same way we can assume that when the implicit situation argument is provided explicitly, as e.g. with *if*-clauses, then it can be introduced in accordance with information structure needs. The choice between having it decorate a LINKed or unfixed node is then controlled by such considerations and the intended construal cannot be determined but by taking into account the specific context of utterance (i.e. there is no structural encoding of Topic or Focus features or

⁷⁸ Ford (1989) and her own.

⁷⁹ Even when the data have only included unambiguously conditional, rather than temporal, interpretations.

interpretations). So in the same way that the specific informational status of a pre- or post-posed subject in a pro-drop language like Modern Greek cannot be determined outside the context of processing we can presume that in languages like English both post-posed and pre-posed *if*-clauses can decorate either unfixed nodes or LINK structures, with disambiguation a matter of the specific context of utterance. However this claim seems to contradict the widespread assumption that *if*-clauses behave as “topics”.

2.h.1. If-clauses as topics

Examining cross-linguistic distributional evidence Haiman (1978) and Haiman (1993) have claimed that *if*-clauses are generally *topics*. From the present perspective, this claim is contradicted by the fact that *if*-clauses can occur post-verbally without any necessary indication of a revision, afterthought construal or recapitulation effect. Notice also that such postverbal *if*-clauses can accommodate anaphoric elements which depend for their content on the previous clause and contributing to the complex predicate predicated of the subject:

(85) Every student will succeed if he is not lazy

If protases were consistently “topics”, i.e. introducing background or given information, such dependencies are not easily explained. Moreover, although it has been claimed (Rooth 1985) that *if*-clauses, unlike *when*-clauses, cannot be focussed, von Fintel (1994) and Bhatt (1996) show that *if*-clauses can both be the new information conveyed by an answer to a question and bear nuclear accent:

(86) A: What would motivate John to shave?
B: John always shaves, [if his MOTHER is coming to visit]_F

Even though this data is problematic for the *conditionals-as-topics* thesis (and therefore for a single LINK dislocation analysis from our perspective) it is not problematic for the analysis of *if*-clauses as contributing restrictors to quantificational terms. As von Fintel (1994) shows restrictors in nominal terms can also be focused:

- (87) A: Who here is clever enough to solve this problem?
 B: Well, *most of the* [GRAD STUDENTS]_F should be able to help you.

For the present analysis of *if*-clauses as relatives we can observe that elements in a relative clause can also be focused:

- (88) A: Did you see the man that John dislikes?
 B: No, but I saw the woman that John [ADORES]_F
 (89) A: Who did John hit?
 B: John hit whoever APPROACHED

We take these as justification for postulating two structural types of analysis underlying conditional sentences. From this point of view, *if*-clauses can be seen as providing the context for the processing of the consequent but in the sense of providing explicitly the situation argument and the domain of quantification. In such cases *if*-clauses can convey new information and we assume that the analysis as decorating unfixed nodes is more appropriate:

- (90) A: Under what conditions are you prepared to surrender?
 B: [(Only) If JOHN surrenders]_F I might do.
 (91) A: Are you going to play soccer on Sunday? (von Fintel 1994: 82)
 B: We'll play [if the SUN shines]_F

On the other hand, we assume that the specific interpretation usually characterised in the literature as *topic*, i.e. “given” or “background” information, is only available at the left-periphery under a construal in which a left-peripheral *if*-clause is processed as the *head*, the point from which the LINK relation originates. This is a natural characterisation since only in this structure can we assume that what is provided initially is given explicitly as the context for processing the following assertion. For cases of LINKed subtrees contributed by right-peripheral *if*-clauses we saw that they provide confirmation for the choice of an already contextually given element.

In any case we assume that interaction with the context of utterance is essential not only for enriching the underspecified content provided by linguistic means (see e.g. Noh 1996) but also for determining which particular structural option was intended. Nevertheless, as expected, there are languages where we can see that “grammaticised” encoded indications of

which of the two structural options is intended exist at least as far as the left periphery of the clause is concerned (as, for example, there are languages like Japanese where there is explicit encoding of a LINK construal by means of a topic marker like *wa* see Cann et al. 2005: Ch. 6). These languages are the V2 Germanic languages to which we turn next.

2.h.2. V2 in German, Dutch, Afrikaans

As we saw in the previous chapter, some V2 Germanic languages allow conditional antecedents in the left periphery to appear in three distinct syntactic patterns^{80,81}:

- (a) the protasis occurs clause-initially and is immediately followed by the finite verb in the apodosis:

- (92) *German (from Koenig & van der Auwera 1988)*
 [Wenn er krank ist] bleibt er zu Haus
 if he sick is, stays he at the house
 If he is sick he stays at home
- (93) [As hy siek is] bly hy by die huis *Afrikaans*
 if he sick is stays he at the home
 if he is sick then he stays in the house

- (b) the *if*-clause precedes another constituent and the finite verb follows:

- (94) [Wenn du mitkommen willst], ich habe nichts dagegen *German (ibid)*
 if you come-along want, I have nothing there-against
 If you want to come along, I don't mind.
- (95) [As jy wil saamkom], ek gee nie om nie *Afrikaans*
 if you want come-along, I give not about not
 If you want to come along, I don't mind

- (c) the clause-initial *if*-clause is followed by the resumptive element *dann* with the finite verb following:

- (96) [Wenn er krank ist], dann bleibt er zu Haus *German (ibid)*
 if he sick is, then stays he at the house
 If he is sick he stays at home

⁸⁰ We use Afrikaans data to illustrate points here because this is the language to which we had native speaker access and so did not rely only on examples found in the literature.

⁸¹ The protasis can also appear postverbally but we will ignore this option here as we do not assume that its analysis differs from English:

- (1) *German (from Auer 2000)*
 Sie müssen n bisschen auf Punkt kommen wenn sie job haben wollen
 you need to get down to the point if you want to have a job.
- (2) hy bly by die huis, as hy siek is *Afrikaans*
 he stays at the house, if he sick is
 He stays at home if he is sick

- (97) [As hy siek is] dan bly hy by die huis *Afrikaans*
 if he sick is then stays he at the home
 if he is sick then he stays in the house

In these languages the phenomenon traditionally termed V2 refers to the requirement that the finite verb occurs in second position after a constituent perceived to be in some way distinguished. Note that, as seen above in (94), the requirement is *not* that the finite verb must literally always be the second constituent since topical elements can appear sentence-initially (usually with an intonational break separating them from the rest of the structure). Kempson et al. (2001:173) analyse the V2 requirement in German as the obligatory presence of an unfixed node initially before the verb is processed. The verb which is then taken as locally unfixed, i.e., as unfixed within a single propositional tree, can decorate a separate node⁸². The first distributional pattern observed above in (92) shows that the protasis can count as the first constituent for V2. This necessitates an analysis of such clauses as providing initially unfixed nodes as this is the only compatible option with the DS analysis of the V2 phenomenon. On the other hand, the next two patterns show that the protasis can be more “peripheral” in the sense that another constituent that follows it can assume the role of the first element for the satisfaction of the V2 requirement. If the latter is to be analysed as providing the unfixed node required for V2 then the only other option remaining for the analysis of the *if*-clause is as providing content which appears on a node LINKed to the main tree⁸³. Thus the reported topical character of such elements and the intonational break characterising them can be given formal characterisation by the grammar. However, the fact that such externalised elements are processed independently but in parallel with the apodosis does not make it necessary that they have to be taken as, somehow, embedded constituents with an encoded determinate semantic contribution to the overall

⁸² Though in the shift from Kempson et al (2001) to Cann et al (2005), this account would not be sustained, preferring rather to analyse German along lines similar to Irish, with a full propositional template induced by a verb from a requirement ?Ty(t).

⁸³ This factor may reflect a lexical specification of the verb following not the Kempson et al. (2001) pattern proposed for German, but rather following Irish, as triggered by the pointer being at a node decorated with ?Ty(t) (see Cann et al 2005).

interpretation of the structure (i.e. we do not have to define any projection with an encoded semantics, e.g. Topic, of the main clause in order to integrate their processing). The option of using the LINK connection that DS provides can account for a looser correlation, providing the context for the processing of the following string, which can be pragmatically enriched depending on the context of processing.

For our purposes here, it must be taken into account that DS is not a “syntactic” framework in the traditional sense where only distributional/structural criteria justify a proposed analysis. In contrast, since DS is modelling the processing mechanism and its interaction with context, both what have traditionally been called “semantic” and/or “pragmatic” evidence provide justification for any proposed analysis. In that respect, the distinct interpretations associated with protases according to their left-peripheral position in V2 languages gives us clues for distinct structural analyses. The clearest indication that non-integrated protases are interpreted differently comes from the interpretation of what has been characterised “relevance conditionals” (see above 1.a.3). Bhatt & Pancheva (2001) report that in Dutch and some other V2 languages the protasis of a relevance conditional never counts as the first element for V2. This seems to be supported by native speakers’ intuitions. Consider the Afrikaans examples below:

- | | | |
|-------|---|------------------|
| (98) | As jy my nodig het, ek is by die kantoor
if you me need has, I am at the office
If you need me I am at the office | <i>Afrikaans</i> |
| (99) | #As jy my nodig het, is ek by die kantoor
if you me need has, am I at the office
If you need me I am at the office | |
| (100) | As iemand my soek, ek is in die biblioteek
if someone me seek, I am in the library
If someone looks for me I am in the library | |
| (101) | #As iemand my soek, is ek in die biblioteek
if someone me seek, am I in the library
If someone looks for me I am in the library | |

- (102) As jy honger is, ek het aartappels gekook
 if you hungry is, I have cooked potatoes
 If you are hungry I've cooked potatoes
- (103) #As jy honger is, het ek aartappels gekook
 if you hungry is, have I cooked potatoes
 If you are hungry I've cooked potatoes

According to native speakers' judgements, it is not the case that (99), (101) and (103) are ungrammatical as strings. However when these strings are interpreted it is reported that there are strong intuitions that what is asserted is that there is some particular "causal-consequential" relation relating the two situations described in the two clauses. For example in (103), there must be some cause-effect connection between the addressee's being hungry and the speaker's having cooked potatoes (this can be paraphrased in English as *if you are hungry THEN I have cooked potatoes*). Since this interpretation is not readily available out of context the examples are judged as weird or unacceptable. On the other hand, speakers report structures like those below as completely unacceptable when *if*-clauses do not appear immediately preceding the finite verb. This is presumably because it is difficult for such structures to be interpreted as not indicating a strong connection between the two clauses:

- | | | |
|-------|---|------------------|
| (104) | As hy siek is, bly hy by die huis
if he sick is, stays he at the house
If he is sick he stays at home | <i>Afrikaans</i> |
| (105) | *As hy siek is, hy bly by die huis
if he sick is he stays at the house
If he is sick he stays at home | |

So we can assume that in a language like Dutch or Afrikaans the distinction between taking the protasis as decorating a LINKed ("unintegrated") or unfixed node ("integrated") is indicated by examining the position of the verb⁸⁴. However, this is not to say that there is a particular semantics associated with such differentiation. Remember that, as we saw earlier in (22)-(24), degree of integration does not differentiate between Haegeman's

⁸⁴ This is not the case for German or Scandinavian V2 languages which exhibit different patterns.

(2003) “event” or “premise” conditionals, both of these types can appear as integrated:

- (106) A: Die wynbottel is halfleeg *Afrikaans (English examples from Noh 1996)*
 the wine-bottle is half-empty
 the wine bottle is half-empty
 B: As dit halfleeg is, is jy 'n pessimis
 if it half-empty is, are you an pessimist
 If it is half-empty, you are a pessimist

And, as predicted by the relevance-theoretic analysis of Noh (1996) there is no strictly syntactically/semantically definable category of “relevance” or “speech-act” conditionals in the sense of conditionals with protases providing conditions for the execution of the following speech act. The following can be interpreted neither as an “event-” nor a “premise” conditional:

- (107) (Son to Mother going out): *(from Noh 1996: 28)*
 Mum, don't worry. If I'm hungry, there's a sandwich in the fridge.

On the other hand, although it seems similar in interpretation to a “relevance-” or “speech-act-” conditional, the left-peripheral *if*-clause cannot be interpreted as providing a felicity condition for the speech act of informing the mother that there is a sandwich in the fridge. Nevertheless, notice that such conditionals are preferably processed as non-integrated in Afrikaans:

(Son to Mother who is going out:)
 Ma, moenie bekommerd wees nie. *Afrikaans*
 Mom must-not worry be not.
 Mum don't worry...

- (108) ...As ek honger is, *daar is* 'n toebroodjie in die yskas.
 ...If I hungry is, there is a sandwich in the fridge.
 ...If I am hungry, there is a sandwich in the fridge.
 (109) ...#As ek honger is, *is daar* 'n toebroodjie in die yskas.
 ... If I hungry is, is there a sandwich in the fridge.
 ...If I am hungry, there is a sandwich in the fridge.
 (110) ...As ek dors is, *Pa het* lemonade gekoop.
 ...If I thirsty is, dad has lemonade bought.
 ...I am thirsty, dad has bought lemonade.
 (111) ...#As ek dors is, *het Pa* lemonade gekoop.
 ...If I thirsty is, has dad lemonade bought.
 ...I am thirsty, dad has bought lemonade.
 (112) ...As ek honger is, *die aartappels is* reg
 ...if I hungry is, the potatoes are ready
 ...If I am hungry, the potatoes are ready

- (113) ...#As ek honger is, is die aartappels reg
 ...if I hungry is, are the potatoes ready
 ... If I am hungry the potatoes are ready

This is means that there is no well-defined class by either semantic or syntactic criteria that can be termed “relevance” or “speech-act” conditionals. There is a syntactic distinction between integrative or non-integrative processing and this can be exploited for the derivation of many types of contextual effects. Therefore, contrary to widespread assumptions, we cannot accept any syntactically encoded semantic differentiation between types of conditionals. What we can assume is that the distinct ways defined by DS of processing the underspecified input provided by the protasis can be the basis for distinct types of contextual effects as predicted by relevance-theoretic assumptions.

To sum up, the review of the data above leads to the conclusion that even though English does not provide the appropriate explicit syntactic evidence, there is in fact a distinction between peripheral and more integrated protases, a fact reflected in their analysis as either decorating a LINKed subtree or an unfixed node. However, we cannot take these evidence to necessitate an account where types of *if*-clauses are syntactically marked as internally deficient or not and accordingly associated with a specific interpretation because as we saw which of the two structures is intended in each occasion is disambiguated by the specific context of occurrence according to relevance-theoretic assumptions.

2.i. Universal Quantifiers and LINK

One last objection that might be raised against the LINK analysis above might be that the NPs in English whose processing results in τ -terms (unlike indefinites and proper names) do not have a use where they can be analysed as providing the head in a LINK structure:

- (114) *Every student, he left

However NPs with the universal determiner *all*, which must also be analysed as contributing τ -terms, seem to be able to appear in such structures:

(115) All of my friends, they abandoned me.

Moreover universal determiners in other languages are not excluded from these structures. In languages with clitic doubling, universal determiners, even of the every kind, can appear in CLLD constructions:

- (116) Kathe fititi ton ida na fevgi Modern Greek
 Every student him-saw-me to leave
 I saw every student leaving
- (117) Ton kathe fititi ton ida na fevgi
 the each student him-saw-me to leave
 I saw each student leaving
- (118) Kathena fititi ton ida na perni tin tsanta tou ke na fevgi
 each student him-saw-me to take the bag his and to leave
 I saw each student taking his bag and leaving

Romanian from Alboiu (2002)

- (119) Pe fiecare elev, cu ocazia olimpiadelor, I-a felicitat profesorul.
 PE each student with occasion contests-the-DAT him-AUX congratulated teacher-the
 'The teacher congratulated each student on the contests.'
- (120) cu ocazia olimpiadelor, pe fiecare elev I-a felicitat profesorul.
 with occasion contests-the.DAT, PE each student him-AUX congratulated teacher-the
 'The teacher congratulated each student on the contests.'
- (121) Pentru fiecare elev, fiecare profesor a pus o vorbă bună.
 for each student each teacher AUX.him put a saying good
 'Each teacher put in a good word for each student.'
- (122) Fiecare profesor pentru fiecare elev a pus o vorbă bună.
 each teacher for each student AUX.him put a saying good
 'Each teacher put in a good word for each student.'

Romanian (data provided by Udo Klein (pc.))

- (123) Pe fiecare student I-am vazut cautind ceva si apoi plecind.
 Pe every student him-have seen looking-for something and then leaving
 Every student I saw him looking for something and then leaving

Spanish from Zubizaretta (1996)

- (124) A cada nino, (estoy segura que) su padre lo acompanara el primer dia de escuela
 ACC each child, (I-am sure that) his father-ACC him will-accompany on the first day of school
 Each child, (I am sure that) his father must accompany the first day of school

- (125) A cada uno de sus amigos, Pedro lo invito a cenar
 ACC each one of his friends, Pedro him invited to dinner
 Each one of his friends Pedro invited for dinner

Spanish from Arregi (2003):

- (126) Cada libro, *(lo) leyó Juan, y cada revista *(la) leyó Pedro.
 each book *(it) read Juan and each magazine *(it) read Pedro
 Each book, Juan read, and each magazine, Pedro read.
- (127) Cada libro, lo leyeron menos de tres estudiantes.
 each book it read less than three students
 Each book was read by less than three students

Catalan (from Vallduvi 1990: 153, fn. 91)

- (128) A tots els estudiants_i els_i donen un carnet *t_i*
 to all students them give an ID
 To all the students they give them an ID
- (129) A tothom_i no el_i tracten igual
 everybody_i not him_i treat equal
 Everybody they don't treat the same

In the Romance languages cited and Greek, one might analyse these structures as involving a metavariable projected by the clitic with no bottom restriction (see chapter 2 and Cann et al. 2005), hence compatible with Merge of an unfixed node decorated by the quantifying expression; but this does not match the dative-object asymmetry displayed in Romanian (in which only the dative allows free doubling by all forms of NP expression with no specificity effect).

Furthermore, in Hungarian universal quantifiers can appear to the left of the VM position, and also to the left of preverbal focus. If focalised constituents are analysed as unfixed nodes in this language then we have to assume that the universals decorate LINK structures.

- (130) Minden verset fel olvasott János *Hungarian*
 every poem-acc up read J.-nom
 John read out every poem'
- (131) Minden verset JÁNOS olvasott fel
 every poem-acc J.-nom read up
 For every poem, it's John who read it out

But even in English left dislocation of universal quantifiers is possible as the following pieces of text from the web seem to indicate (see Appendix 2 for sources and context):

- (132) Every person who crosses his path, he affects them in a positive way

- (133) Mr. Harris made contact with Pacific residents in all three wards. He stood out in front of stores, the post office and other locations around the city. Each person who he contacted, he asked their opinion on this issue. Not once did Mr. Harris find a resident who was in favor for an appointed chief of police. This gave me hope for the residents of Ward 3 because Alderman Harris does care for your opinion.

- (134) As for everyone who keeps imagining what they would have done, how they would have reacted, etc, the thing you are all forgetting is that you probably don't have the training and resources that the President of the United States has.

We conclude therefore that there is no inherent restriction banning the presence of τ -terms as heads in LINK structures. However such terms, like the epsilon terms derived by indefinites must be, in some sense to be explained by a pragmatic theory, “given” or “topical”. Given the context-dependency of conditional interpretations it does not seem unreasonable to assume that they are, in some sense, topical (cf. Schlenker 2004, Schein 2001).

CHAPTER 7

ANAPHORA AND THE PROCESSING OF CONDITIONALS

1. Conditionals and Anaphora: the static view vs. the dynamic analysis

Transformational accounts attribute multiple structural ambiguities to conditional sentences (see e.g. Iatridou 1991, Bhatt & Pancheva 2001/2005; Chierchia 1995). Not only are there different structural positions assigned to preverbal and postverbal *if*-clauses, it is also the case that preverbal *if*-clauses are ambiguous between base-generation in that position and movement from a more deeply embedded position. Moreover the final LF position of such an *if*-clause might involve movement back to its base position (*reconstruction*). The main evidence for such multiple structural analyses is provided by the anaphoric relations permitted among nominal arguments inside a sentential domain (*Binding Theory*) and quantifier-variable binding.

As discussed in the previous chapter, the present account also assumes that, as in structures involving nominals (e.g. Left Dislocation and Topicalisation), conditional structures present an ambiguity with respect to the representations achieved: either the eventual propositional logical form includes a situation argument to which a LINKed tree is attached, or, as in Left Dislocation structures, the *if*-clause content appears at an independent type *e* tree to which the input from the main clause is LINKed. This ambiguity is a minimal one, more or less necessitated by the assumed symmetry as regards the conceptual structures generated by the parsing of nominal and conditional structures and the parallel means provided for processing such strings. Beyond this minimal ambiguity there will be no reason to postulate multiple structural ambiguities and movement processes. In contrast to transformational accounts, the phenomena that have been taken to require the postulation of multiple ambiguities will be dealt with in terms of the procedures invoked in order to parse conditional sentences. The challenge for

the present approach is therefore to replace the transformational accounts, which exploit multiple structural levels related by movement, with procedural explanations of the same phenomena. As a primary instantiation of this challenge, in this chapter, we have to show that the alleged evidence provided by Binding Theory results do not support the postulation of multiple structural analyses. This will be achieved by showing that when the dichotomy between syntactic and discourse accounts of anaphoric phenomena is removed in favour of an underspecification account of anaphora we can provide non-structural solutions for several binding problems in the intra-sentential domain. Obviously, we cannot possibly hope to provide here a complete theory covering all the phenomena involving anaphora resolution which have occupied linguists since the sixties. For example, “picture reflexives” will not be considered since they have been argued to solely involve ‘point of view’ and other pragmatic considerations (see e.g. Sag & Pollard 1992, Sag et. al. 2003, Reinhart & Reuland 1993) and since they do not interact significantly with the processing of conditionals; we address cataphoric effects but only in the limited intra-sentential domain¹. All in all, we will only attempt to provide an explanation for phenomena that interact with our modelling of the processing of conditionals and examine whether they justify the syntactic analyses that have been proposed to account for them or whether the present DS account provides adequate alternative explanations. If the latter is the case then we will have achieved an overall simplification in the analysis of conditionals since we avoid the unnecessary postulation of linguistic ambiguities by exploiting the dynamics of processing and underspecification of content.

¹ There are many other cases of cataphoric effects (see, e.g. Carden 1982, van Hoek 1996) which might require a treatment similar to the one provided by van Deemter (1991). In present terms this will involve the establishment of a weak epsilon term to be fully identified later on. We believe this to be compatible with the approach presented here but we take the view that this is a separate phenomenon from the intrasentential cases discussed later.

2. The Problem: Patterns of Anaphora with Conditionals

The resolution of anaphoric relations between nominals is an issue that has attracted a lot of interest in the linguistic literature. There is an on-going debate regarding which is the most appropriate domain for understanding how resolution of anaphora operates. The pertinent question seems to be how the labour is divided between the grammar and discourse/pragmatic considerations. If discourse requirements are taken to determine linguistic structure then the linear order of nominals in a piece of discourse is a crucial factor for anaphora resolution. This perspective will lead us to expect that a pronominal must necessarily follow the nominal it is associated with (its *antecedent*):

- (1) John_i left. He_i was tired
- (2) ?He_i was tired. John_i left
- (3) A man_i came in. He_i was tired
- (4) #He_i was tired. A man_i came in.

Considering the acceptability patterns in the above sentences we are led to the conclusion that even if it might be marginally possible to have a proper name following a coreferential pronoun in a separate sentence ((1)-(2)), when a quantified expression is used this pattern becomes completely unacceptable. The natural explanation for this situation is that a “quantificational” term, such as an indefinite noun phrase, is normally used to introduce a new individual in the discourse context (see e.g. Kamp & Reyle 1993, Heim 1982 a.o.). Since discourse is processed sequentially, reference to a newly introduced entity by a pronominal cannot be feasible prior to its introduction by a full NP (unless delaying strategies are employed). The same pattern seems to appear within the boundaries of one sentence which might lead to the conclusion that there is nothing more to be said about anaphora either at the grammatical (intra-sententially) or the discourse level (inter-sententially):

- (5) John left and he was tired

- (6) ?He was tired and John left².
 (cf. He_i looks at me and John_i goes out of his mind. Bolinger 1979: 304)
- (7) A man_i came in and he_i was tired
- (8) #He_i was tired and a man_i came in.
- (9) *He_i said that John_i is hungry.
- (10) *He_i said that a man_i is hungry

However, conditional constructions are one of the main domains that seem to cause complications for such a common sense theory of anaphora. If there is a discourse requirement that pronouns must follow their antecedents then it seems to be violated in the following cases:

- (11) If he_i is happy, John_i smiles.
- (12) If John_i is happy, he_i smiles.
- (13) If he_i is happy, a friend of mine_i smiles.
- (14) Every mother_i is upset if her_i child is late from school (from Iatridou 1991)
- (15) If her_i child is late from school every mother_i is upset
- (16) If he_i is late a man_i will start making excuses
- (17) If he considers it too difficult, a teacher won't adopt a textbook
 (from Chierchia 1995)³
- (18) If he lies to a student, a teacher loses his trust (*ibid*)

Comparing the situation displayed above with the pattern in (9) (**He_i said that John is hungry*), it seems that in the case of clause-initial conditional protases the putative discourse rule regarding the obligatory antecedent-pronominal order is violated. We will now see how this issue has been addressed in the literature.

² Other counterexamples to the general ungrammaticality of the pattern in (6) include:

- (i) I haven't seen him_i yet but John is back. (Mittwoch 1983: 131)
- (ii) He_i hasn't contacted me, but I'm sure John_i is back. (Reinhart 1983: 55)
- (iii) Mary hugged him_i and Nancy kissed John_i. (McCray 1980:335)
- (iv) She's almost sixty-five, and therefore Mary_i won't be hired by anyone. (McCray 1980:336)

³ The native speakers we have consulted disagree with Chierchia's data regarding the "paradigm of backwards donkey dependencies" (Chierchia 1995: 129-133) especially when more data sentences are considered. The general view is that crossing dependencies are difficult to process in any case and that there is no clear-cut pattern concerning acceptability judgements. Therefore we will have nothing to say about such data.

3. The syntactic solution: Binding Theory

The fact that there are contrasting acceptability judgements concerning (9)-(10) and (11)-(16) above has led to the proposal that there are separate intra-sentential syntactic constraints which determine permitted patterns of anaphora. This seems to be a justified move in the case of specialised pronominals, *reflexive pronouns*, which must be licensed by an antecedent in the same sentence:

(19) John_i left. Mary insulted himself_i

(20) *John_i said that Mary hated himself_i

Moreover, in contrast to the above distribution, the ordinary type of pronominals seem to not to be able to appear in a domain that is too local to their antecedent. Such domains seem to be defined by finite clauses again:

(21) *John_i likes him_i

In addition, there is also an assumption that referential expressions like proper names cannot appear in positions that bear specific structural relations to coreferential pronouns:

(22) *He_i likes John_i

This view of the data seems to suggest that such anaphoric relations can be treated as syntactic dependencies in a local sentential domain and that we should be able to determine syntactic principles that govern permitted and disallowed coreference relations between nominals in sentences. One issue that immediately arises in such an approach is how to define the appropriate relation between such pronominals and their antecedents. It has been proposed that the relevant relations are determined inside an individual syntactic tree and a domain that is defined by a tree node's sister and the sister's descendants (the *c-command* domain). The (simplified) c-command relation between tree nodes is defined as follows:

(23) A **c-commands** B if neither dominates the other and the first branching node dominating A also dominates B. (adapted from Reinhart 1983)

The c-command constraint on syntactic dependencies has been seen as a major structural relation involved in many syntactic explanations like *wh*-movement, quantifier scope, negative polarity licensing etc. If we now assume that the reference of an NP is determined, or at least restricted, by a syntactically assigned index we can then construct conditions that allow or disallow co-indexing between the nominals occupying nodes on the tree. These indexings can be seen as constraining coreference relations among the nominals in a sentence⁴. A nominal co-indexed with a c-commanding NP is said to be *bound* by that NP. Now we can define a syntactic theory regulating the binding relations between antecedents and pronominals. This theory is called *Binding Theory* and it concerns conditions on indexing. The main postulate of Binding theory is that binding is subject to c-command and that different types of NPs have distinct binding restrictions. These are determined as follows⁵:

(24) Binding conditions:

- Condition A: An anaphor must be bound in its local domain.
- Condition B: A pronoun must be free in its local domain.
- Condition C: An R-expression must be free everywhere

It is assumed that R-expressions (i.e. referential expressions like the proper names *John* or *Mary*) c-commanded by a coindexed antecedent will yield ungrammaticality. On the other hand, *anaphors* (e.g. reflexive pronouns like *himself*) need a c-commanding coindexed antecedent inside a local domain roughly defined by a single verb and its nominal arguments⁶. *Pronouns* can take a coindexed antecedent as long as it does not appear in a local domain

⁴ There are many interpretations of what indexing actually does and what it refers to, see e.g. Higginbotham (1983), Chomsky (1981), Evans (1980), Reinhart (1983), Reinhart (2002), Heim (1998). We are only presenting a general simplified view here compatible with the three transformational analyses of conditionals that we will address.

⁵ One should note here that with the advent of the Minimalist Program (Chomsky 1995) the coindexing mechanism which provided the basis for the expression of binding-theoretic constraints has become untenable and reformulations have been sought (see e.g. Reuland 2001). However since the relevant works concerning conditionals presuppose the GB version of Binding Theory (apparently even Bhatt & Pancheva 2001 who rely on Iatridou 1991) we have to address binding theoretic restrictions in this format.

⁶ For the definition of a "local domain" (as a *minimal governing category/minimal complete functional complex*) utilised in the accounts presented see Chomsky (1980), Chomsky (1981), Chomsky (1986: 169).

roughly equivalent to the domain determining the dependency between an anaphor and its antecedent. After a suitable definition of what a *local domain* consists in, Binding Theory can explain the co-indexing possibilities observed above in (19)-(22). And because the c-command relation on which it is based is a structural relation concerning trees and the relative position of their nodes, Binding Theory results are widely used as diagnostic tests for revealing the constituency structure of various linguistic constructions. We now turn to how these tests have been used in the domain of conditional analyses.

3.a. Binding Theory and Conditionals

3.a.1. The Transformational Account of Conditionals: *Iatridou (1999), Bhatt & Pancheva (2001), Chierchia (1995)*

In transformational analyses, possible anaphoric relations between nominals are taken as a diagnostic for hierarchical structure and movement. This is because it is assumed that anaphoric possibilities are governed by principles making reference to the c-command domains of nodes in the tree structure. However, when the anaphora results do not correspond with otherwise justified structural representations, modifications of the tree structure are employed in order to make the c-command requirement compatible with the data. This type of incongruity is also observed when the anaphoric relations between terms in the protases and the apodoses of conditional constructions are examined. For this reason multiple structural representations, either related to each other by movement or not, have been employed in the literature. We will examine two such proposals in detail now.

The main diagnostic that has been used in these accounts is Principle C of Binding Theory above: Full NPs (*R-expressions*) are restricted in that

they cannot be c-commanded by coreferential pronouns (see Chomsky 1981)⁷:

(25) *He_i said that John_i is tired

(26) John_i said that he_i is tired

Principle C is the main diagnostic utilised by Iatridou (1991) and Bhatt & Pancheva (2001) in defining the syntactic structure that should be assigned to conditional sentences (Chierchia 1995 accepts most of these results). We will see now what kind of structures for conditionals this criterion leads those accounts to postulate.

3.a.1.a. *Preverbal if-clauses*

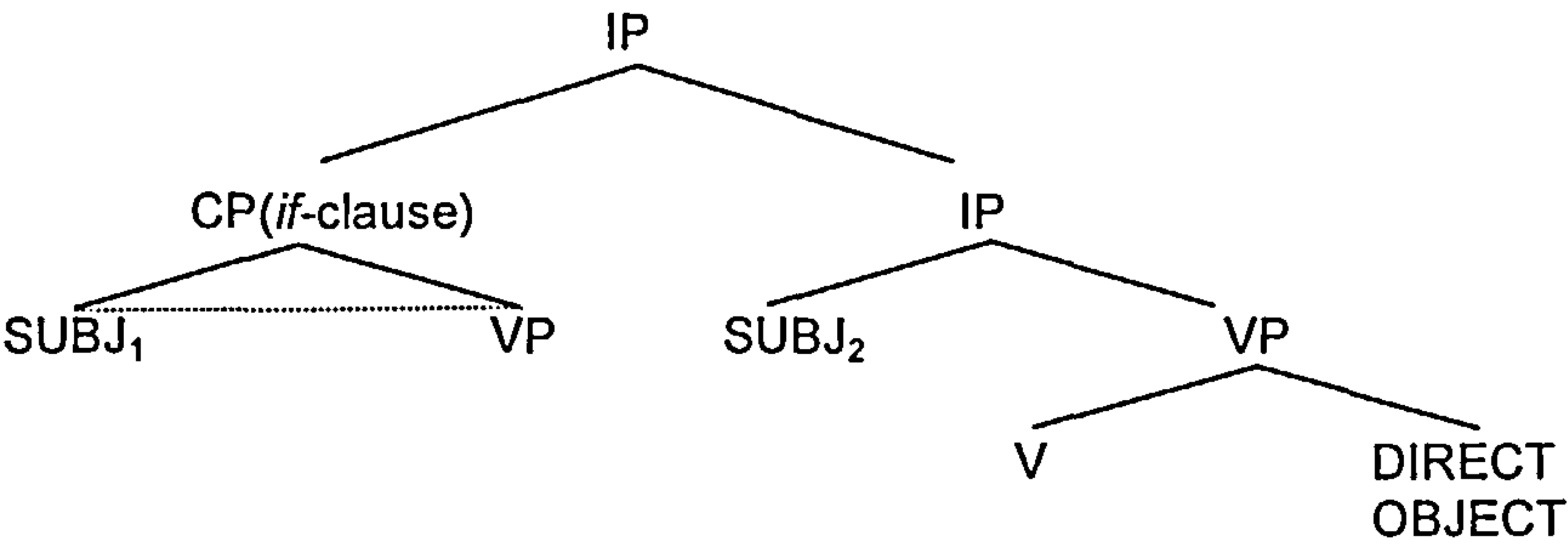
As evidence that the linear order of nominals is not decisive for their coreference possibilities sentences like the following are usually presented:

(27) [If she_i is hungry], Mary_i yells at Bill.

Instead of linear order, what is deemed relevant for the possible coreference relation seen above is the c-command relations among nodes and the stipulation that a pronoun should not c-command its antecedent, or, in other words, that a full NP should not be *bound* by a c-commanding pronoun (*Principle C*). Assuming that a preverbal *if*-clause is adjoined to IP, by most definitions of c-command, the subject of the *if*-clause cannot c-command the main clause subject since the *if*-clause's sentential node (CP or IP) must count as the first branching node above the subject:

⁷ An alternative formulation is that there is a pragmatic principle mandating that where a bound variable situation could be used a speaker will only avoid it if coreference between the nominals is not intended (see Reinhart 1983, cf. Reinhart 2000). This however does not seem to be the formulation used in the accounts presented.

(28)



Therefore a pronoun in the *if*-clause subject position (SUBJ₁) can be coreferential with a constituent in the main clause (e.g. SUBJ₂) without any grammatical violation given that no c-command relation between the two positions obtains. In the transformational account this is what explains the cataphoric effects with preposed *if*-clauses:

- (29) If she_i's late again Mary_i will be punished
- (30) If she_i's late again we will punish Mary_i

On the other hand, we have to assume that a sentence-initial *if*-clause is not c-commanded by the subject of the main clause (SUBJ₂ see the diagram above). This conclusion is drawn because a full NP subject in the *if*-clause can be coreferential with the main clause pronominal subject, cf. (31). If the subject of the main clause were able to c-command the subject of the protasis ungrammaticality should ensue in a similar way as in the case indicated in (32) where *she* clearly c-commands *Mary*:

- (31) [If Mary_i is hungry], she_i yells at Bill.
 $\sqrt{\text{no-c-command}}$
- (32) *She_i said that Mary_i is hungry.
 c-commands

This can be taken to indicate that the sentence-initial *if*-clause is attached higher than the subject position in the apodosis (SUBJ₂ in SpecIP above). In

that respect, *if*-clauses are assumed to contrast with preposed VP-adverbs which do not allow coreference in the same circumstances⁸:

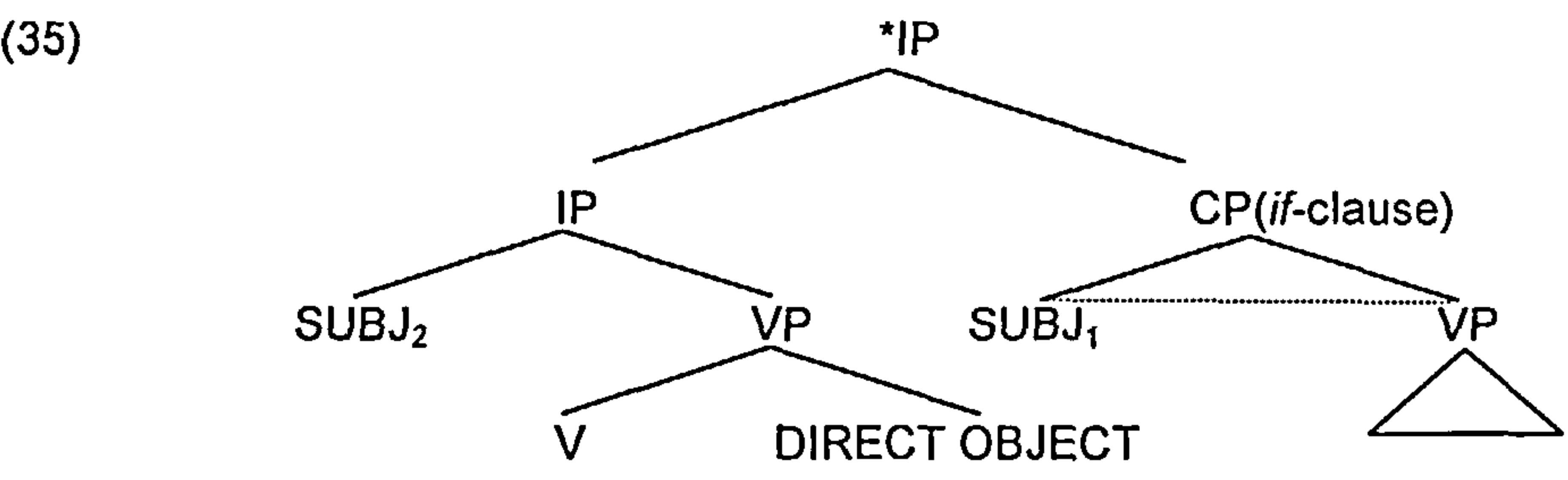
(33) If Dan_i was here he_i would see a snake

(34) *Near Dan_i he_i saw a snake



3.a.1.b. C-command relations in sentences with postverbal *if*-clauses

According to the c-command tests, which disregard linear order restrictions, sentence-final *if*-clauses could not be (right-) adjoined to the main clause in a position higher than its subject. That is, the structural analysis shown below must be excluded:



Firstly, note that as expected the subject of the *if*-clause (SUBJ₁) can be a pronoun coreferential with the main clause subject:

(36) Mary_i yells at Bill [if she_i is hungry].



In this framework this is possible only if there is no c-command relation from the subject position in the protasis (SUBJ₁) to the subject position of the consequent (SUBJ₂). This is what allows the coreference pattern in (36) (and not linear order). This however cannot determine the height of attachment of the *if*-clause because its constituents are restricted in c-commanding

⁸ These data do not really show what is claimed; it seems that it is simply the contiguity of the two elements that causes some perceived awkwardness and 'point of view' considerations that are not syntactically encoded:
(i) Near the house where Dan_i lives he_i saw a snake

elements only inside their own clause. What counts against the structure shown in (35) is strings like the one shown below:

(37) *She_i yells at Bill [if Mary_i is hungry].



If there is a c-command relation from the main clause subject position (SUBJ₂) into the *if*-clause, then a pronoun in the main clause subject position is predicted by Principle C to not be able to corefer with a constituent in the *if*-clause. As this seems to be confirmed with the presumed ungrammaticality of the string above, the test can be taken to indicate that there is a c-command relation between the two subjects. In a binary branching framework, this indicates that post-verbal *if*-clauses are c-commanded and therefore must be attached lower than the main clause subject (again the fact that the pronoun linearly precedes its antecedent is not taken here as the critical factor determining the acceptability or not of the string). Having determined that the *if*-clause is lower than the subject in such frameworks we need to examine what its position is with respect to the Object.

A direct object full NP in the main clause can co-refer freely with a pronominal in an *if*-clause whatever the linear order between the two clauses is:

(38) If she_i is ill, John visits Mary_i

(39) John visits Mary_i if she_i is ill

As we said the nominals inside an *if*-clause can never c-command anything inside the main clause since at least the CP node intervenes. Therefore both the two patterns above are allowed by the grammar and any reduced acceptability must be attributed to other factors. On the other hand, if the protasis were attached lower than the Direct Object position in the apodosis then a full NP in the *if*-clause would not be able to corefer with a pronominal Direct Object. Nevertheless, coreference seems to be allowed in these cases:

(40) Bill visits her_i if Mary_i is sick.

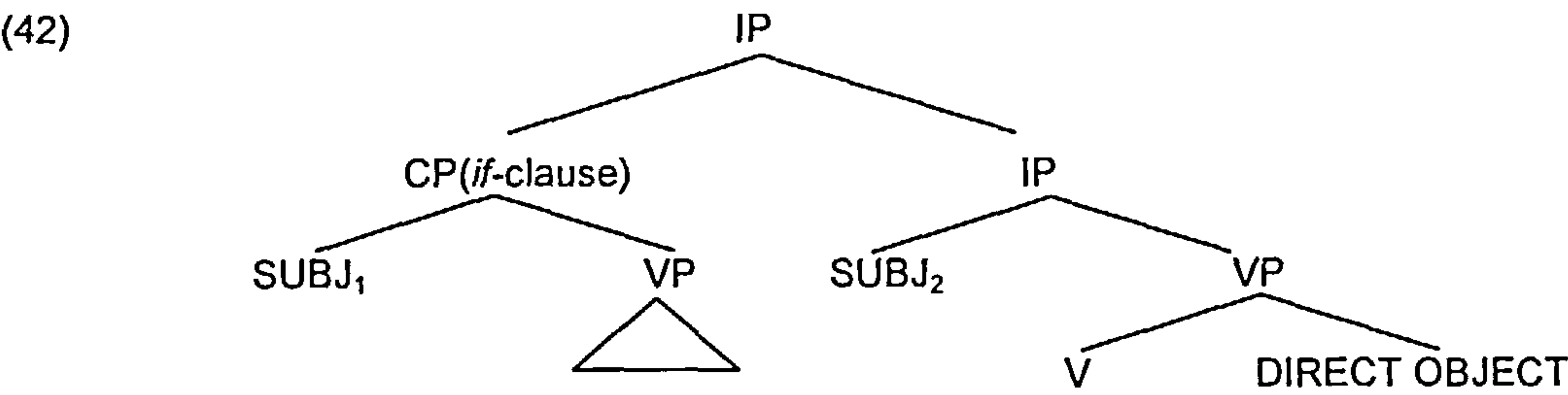
The same situation obtains if the *if*-clause is sentence-initial (remember that linear order considerations are excluded from these explanations):

(41) If Mary_i is sick, Bill visits her_i.

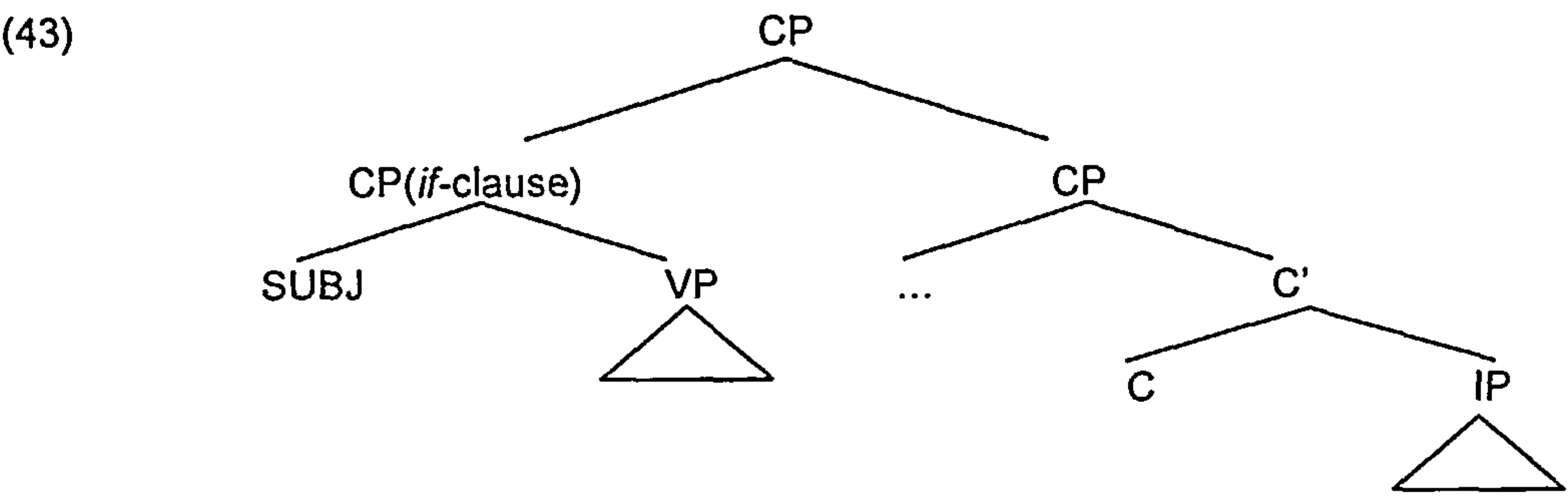
This is taken to show that an *if*-clause is never attached lower than the Direct Object in the consequent.

3.a.2. Iatridou's (1991) structural explanation

Iatridou (1991) concludes from the c-command tests presented above (and some others) that preverbal *if*-clauses are adjoined to the IP node higher than the main clause subject:



They can also be adjoined to the CP so that sentences like the ones in (44)-(46) can be formed:



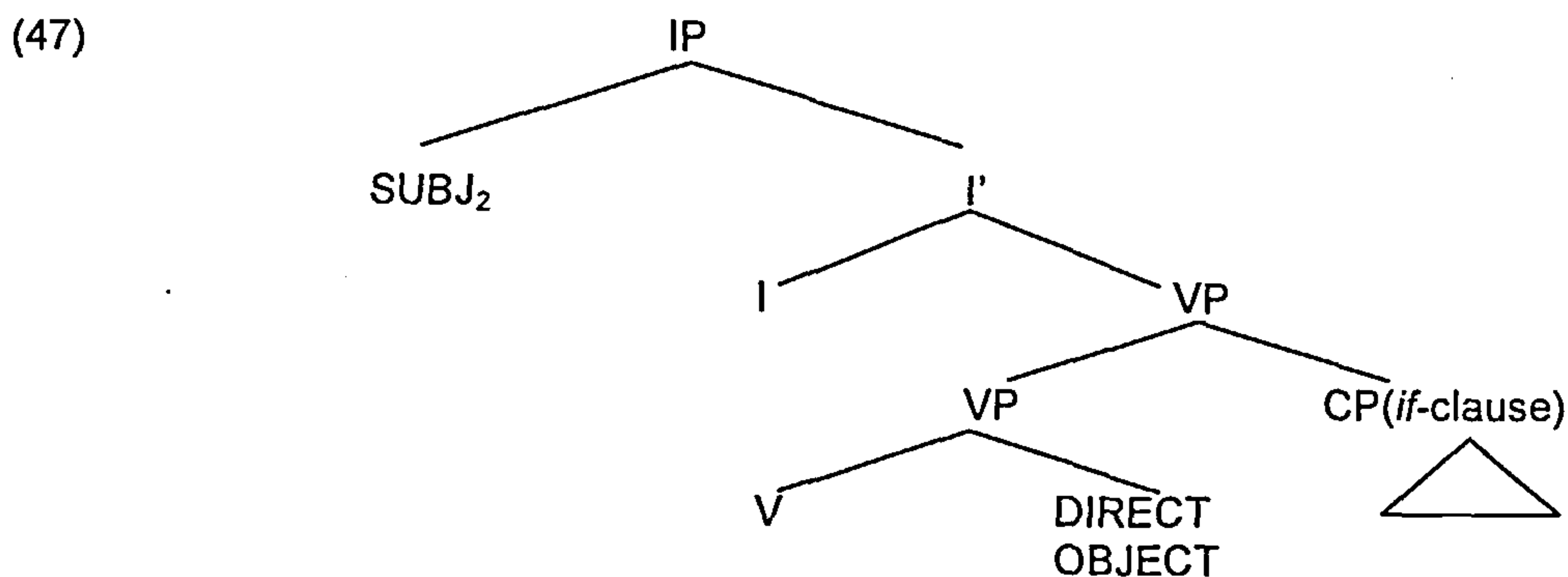
(44) If it rains, what shall we do?

(45) If it rains, are we going to leave?

(46) If he is right, what a fool I've been!

Iatridou argues that the post verbal *if*-clause must be attached lower than SpecIP, the canonical subject position, i.e., it must be adjoined on or included

in the VP. Since the Direct Object does not c-command inside a postverbal *if*-clause in a binary branching framework the *if*-clause would be attached higher than the object:



For sentence-final *if*-clauses it also is assumed that they can adjoin below or higher than negation to account for scopal interaction.

3.a.3. Movement of the *if*-clause

In a transformational framework it is a legitimate question to ask whether the clause-initial and post-verbal positions for *if*-clauses shown above are also related by movement, that is, if strings like (48) have underlying representations in which they are derived from (49):

(48) If it rains, Peter takes the dog out.

(49) Peter takes the dog out if it rains.

According to Bhatt & Pancheva, Iatridou and Chierchia (1995), some sentence-initial *if*-clauses seem to have moved to their surface position from some lower position. The interpretation of sentences like (51) provide the relevant evidence:

(50) John promised that [if you leave] he will leave.

(51) [If you leave], John promised that he will leave.

(51) can mean the same as (50), that is, that John promised that he will leave in case the hearer leaves. Iatridou and Bhatt & Pancheva argue that this shows that there is movement of the *if*-clause in a sentence-initial position and obligatory reconstruction to its base position for interpretive purposes.

Moreover, it is claimed that reconstruction is obligatory because a Principle C violation explains the presumed ungrammaticality of the following:

- (52) *If John_i is sick, he_i thinks that Bill will visit.

However, along with evidence that certain sentence-initial *if*-clauses involve fronting from a lower position, Bhatt and Pancheva and Iatridou claim that there is also evidence that not all sentence-initial *if*-clauses have been moved to their surface structure position. This presumed evidence comes from other reconstruction data. It relies on the claim that surface structure evidence fail to account for claimed Condition C violations observed in data like the following:

- (53) *[Take Peter_i's dog out] though he_i may *t* ...

- (54) *[Which friend of Peter_i's] does he_i like *t* ?

- (55) *[Tell Mary that Peter_i is ill] though he_i may *t*...

If one accepts that these sentences are ungrammatical then it can be observed that in the surface structure there is no indication that the pronoun c-commands the coreferential full NP inside the moved constituent. Therefore the presumed ungrammaticality of the above is unexplained unless one assumes that the moved phrases must obligatorily reconstruct in their base position at some point in the derivation. When this *reconstruction* movement is performed, a condition C violation ensues because now the pronoun will c-command the coreferential full NP.

According to this assumption, if all preverbal *if*-clauses were moved to their surface structure position and if they were obligatorily to reconstruct then one would expect that examples like (56) should have the same grammaticality status as (53)-(55) since after reconstruction they should be identical to (57):

- (56) [If Mary_i is hungry], she_i yells at Bill.

- (57) *She_i yells at Bill [if Mary_i is hungry].

If the sentence-initial *if*-clause had moved to the sentence-initial position and if it was obligatory to reconstruct it back to that position a condition C violation should ensue in (56) in parallel with (57). To explain these data Bhatt and Pancheva claim that since *if*-clauses are adjuncts reconstruction is either not obligatory or not necessary (cf. Lebeaux 1990), which from a minimalist point of view introduces an optionality undesirable in the grammar. In any case, in their view, this accounts for the absence of a condition C violation in (56) in contrast to (57). According to Iatridou, who takes reconstruction as obligatory, the explanation would be that the *if*-clause can be base-generated in its surface structure sentence-initial position and therefore it does not have to reconstruct. As we said above Iatridou claims that reconstruction of a moved *if*-clause is also obligatory in the cases seen above which involve long-distance movement of the *if*-clause from an embedded clause to the matrix. Iatridou also presents evidence that purport to show that reconstruction to a position lower than the subject of the consequent is possible:

(58) John_i will be happy [if pictures of himself_i are on sale].

(59) [If pictures of himself_i are on sale], John_i will be happy.

In (58) it is assumed that binding between *John* and *himself* is licensed because *John* c-commands the VP-adjoined *if*-clause. Since the same licensing obtains in (59) where there is no c-command of *himself* by *John* in surface structure we have to assume in this framework that there is covert movement of the preposed *if*-clause back to a position where it would be c-commanded by the main clause subject *John*. However notice that despite Iatridou's claims c-command does not seem to be relevant in the following cases:

(60) Pictures of himself_i in the garden cost John_i a lot.

(61) Pictures of himself_i in the garden upset John_i.

Therefore it is not certain that what is involved in the licensing of (58)-(59) is Binding Theory postulates. Iatridou also argues for a reconstruction analysis to account for the binding of a pronoun interpreted as a variable by a quantifier:

(62) Every mother_i is upset [if her_i child is late from school].

(63) [If her_i child is late from school], every mother_i is upset.

In this framework it is assumed that c-command has to obtain at some point in the derivation in order for variable binding to be possible. In (62), the quantificational binder *every mother* c-commands in the surface structure the pronoun *her* which can then be interpreted as a bound variable. In the surface structure of (63) though the quantificational binder does not c-command the bound variable pronoun *her* and yet a binding relationship is still possible. This is taken as evidence that there must be a point in the derivation where the sentence-initial *if*-clause comes into the c-command domain of the binder *every mother*.

We will now turn to see whether a different explanation of the data analysed by Iatridou and Bhatt and Pancheva can be provided by taking a more processing-oriented point of view and presenting a different account of how anaphora relations are licensed. We will examine first the reconstruction of the Binding Theory conditions proposed in Kempson et al. (2001) and Cann et al. (2005).

4. Binding Theory and DS

4.a. Anaphora and DS

We saw above that standard syntactic accounts of anaphora assume that, in analogy with anaphors, other types of nominals are also subject to restrictions regarding syntactic locality. Moreover, in these approaches, binding theoretic principles place restrictions on *coreference* relations between expressions. As such accounts are only concerned with intra-sentential, grammatically determined restrictions, separate discourse processes that account for coreference in larger domains have to be assumed. Therefore the phenomenon of anaphora is split across discourse and syntactic explanations with no necessary correlation among them. In contrast to this approach, DS

seeks to define conditions on anaphoric relations that have general discourse and processing justification. Instead of anaphoric relations being viewed as syntactic restrictions on coreference relations among *linguistic* expressions, DS assumes that the basis of anaphora is given by the parser's ability to re-use representations available in context. From this point of view, pronouns are not taken as belonging to distinct categories, according to the syntactic or discourse-semantic restrictions that regulate their distribution (e.g. interpreted as free variables, bound variables, or *E-type*). Instead, all pronominals are analysed as providing temporary place-holders which must eventually be replaced by some suitable conceptual (LOT) representation provided by the linguistic or non-linguistic context. In that respect, antecedents for pronominals cannot be taken to be syntactic elements/words in a natural language (although words, among other resources, are taken to provide antecedents indirectly by introducing terms in the LOT representation).

Under this view, pronominal elements are the par excellence underspecified and context-dependent type of expression. Their sole conceptual content is presuppositional number and gender features which guide the parser to an appropriate substitution for the metavariable that is inserted at the tree node at which the pronominal is processed. In that respect, use of pronouns presupposes that there is an appropriate LOT *expression/concept in context* which can serve as the necessary replacement for the metavariable. Under relevance theoretic assumptions, the use of a pronoun or a definite indicates to the hearer that a representation of the appropriate type is immediately accessible. If there is no such representation provided by the explicit content of the utterance or the speech situation then the hearer will be induced to construct such a representation by exploiting the resources that context makes available. If this is not possible then communication breakdown will occur, in DS terms, parsing of the relevant string will have to be aborted.

We will now see how DS meets the challenge of providing an explanation for the constraints on anaphoric relations in the domain of the sentence for which Binding Theory was devised.

4.b. C-command vs. time-linear processing

Since DS assumes that there is a tree structure resulting from the parsing of any grammatical linguistic string, in principle, the relation of c-command is available as an explanatory tool. All the sentence-syntactic explanations developed in configurational frameworks could, in principle, be transferred to act as restrictions on the LOT representations appearing on DS tree nodes. However, this would not be an analytic solution compatible with other DS assumptions. As DS relies on *Substitution* as the method of anaphoric resolution, the formulation of the principles in (24) above does not provide an account of binding constraints. Consider why that is: Those principles are concerned with statically specifying conditions regarding the coindexing of linguistic expressions. But, at the level at which DS trees are constructed, the information as to which lexical items gave rise to the conceptual content decorating the tree nodes is not recoverable⁹. And the c-command domain of a node cannot possibly restrict co-occurrence of identical conceptual representations because such a restriction is not empirically valid. For example, we could not, and would not like to, provide an explanation for the following ungrammatical string by examining c-command relations and identity of content at the level of the DS semantic tree:

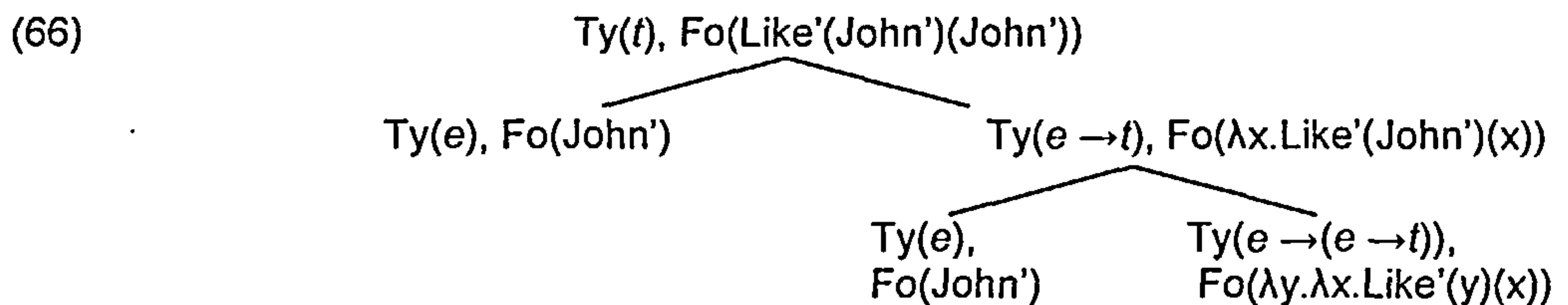
(64) John_i likes him_i

This is because, at that level, there is no restriction prohibiting two identical conceptual representations from c-commanding each other. The tree below in (66) is the one that will result both by the processing of the ungrammatical string above and by the processing of the well-formed string (65) below. This

⁹ Although it is assumed that the lexical *actions* induced by the processing of words are retained temporarily (see Purver et al. 2005).

is a perfectly wellformed semantic representation and therefore cannot differentiate the two strings as far as successful anaphoric relations are concerned:

(65) John_i likes himself_i



We conclude therefore that the Binding Theory conditions which are based on syntactic c-command are not appropriate notions for a DS binding theory. In many alternatives to the transformational account of anaphora, the structural explanation of c-command is replaced by a characterisation of permitted anaphoric relations in terms of an *obliqueness hierarchy* ordering of the arguments of the verb (see e.g. Pollard & Sag 1992, Sag et al. 2003). In principle, this is also an available means of explanation for DS since the resulting representations are semantic structured formulas which can be exploited to provide constraints on the natural language-semantic representation mapping. However, these types of explanation are usually formulated in terms of a static vocabulary which takes an all-at-once overall view of the natural language-semantics mapping. This type of approach, although in principle available to DS at the final stage of the parse, goes against the time-linear methodology of the account and the desired dynamic interaction with context. The alternative that remains is to embed the explanation for permitted patterns of anaphoric resolution in the dynamics of processing defined by the DS formalism. Indeed this is the route taken in Kempson et al. (2001), Cann et al. (2005).

4.c. The time-linear resolution of anaphora

As we saw above the processing of pronominals according to DS provides a metavariable as the Formula value for the node at which the pronoun is

processed. Additionally a requirement that it must be replaced by a proper Formula value accompanies the metavariable inserted. The presence of this requirement will cause a derivation to abort unless it is satisfied. A sample lexical entry for the pronoun *he* is shown below (it includes the specification associated with nominative case, $?<\uparrow_0>Ty(t)$, and the bottom restriction, $[\downarrow]\perp$, indicating that the node being decorated must remain a terminal one):

(67) *he*
 IF $?Ty(e)$
 THEN $put(Fo(U), ?<\uparrow_0>Ty(t), ?\exists x.Fo(x), [\downarrow]\perp)$
 ELSE $abort$

After the set of actions specified above has been executed, the process of Substitution which is responsible for replacing metavariables will select a Formula value from the Discourse Context and insert it at the node. The operation of this process is not strictly part of the parser in that the selection of a substituent is not defined by the computational mechanism which processes lexical input and builds structure¹⁰. Instead selection of a replacement for a given metavariable is determined by pragmatic processes which do not operate in the same (monotonic/incremental) way that the parser functions. However, since Substitution operates in tandem with the parsing process, there are constraints that can be imposed on its selection task by the parser. These constraints can be exploited to provide the basis for reconstructing the effects that Binding Theory was designed to capture. Let's see first how the strings in (64) (**John_i likes him_i*) and (65) (*John_i likes himself_i*) are dealt with in Kempson et al. (2001) and Cann et al. (2005).

¹⁰ Recently a process of *Local Substitution* has been defined in conjunction with the modelling of the operation of the parser in a context (Purver et al. 2005). This variant of Substitution is designed to record the tree path along which a replacement for a metavariable has been found. This stored information then becomes part of the context and can be reused for cases like the resolution of *sloppy readings* in ellipsis. This modelling therefore provides a formal explication of the notion of "linguistic antecedent" for such cases. However as it is not directly relevant to the data discussed here we will omit reference to it in the main text.

4.d. Anaphors

As we said earlier the restriction that governs the distribution of reflexives is defined by Principle A of the Binding Theory. The restriction consists in a requirement that the antecedent must locally c-command the reflexive. In DS terms, such a restriction can be given a procedural definition by a lexically induced obligatory copying of an already present Formula value that appears at an argument node in the propositional tree under construction. In these cases the freely operating rule of Substitution is circumvented by including the appropriate actions for finding a formula value in the lexical entry of these specialised pronominal anaphors, reflexives and reciprocals. Below is the lexical entry for the reflexive pronoun *himself*¹¹:

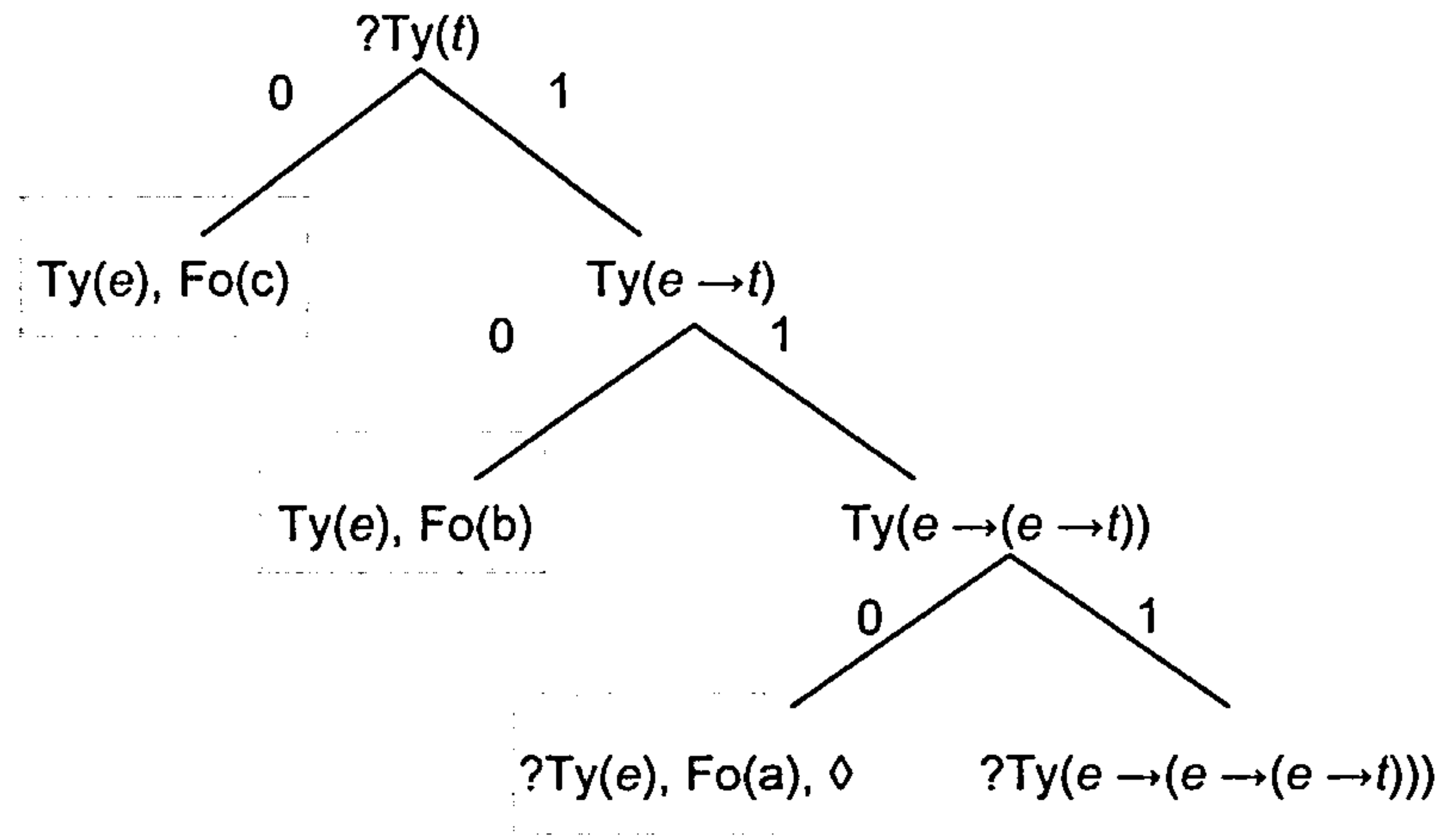
(68)	<i>himself</i>		
IF	?Ty(e)		(1)
THEN	IF	<↑ ₀ >?Ty(t)	(2)
	THEN	abort	(3)
	ELSE	IF	<↑ ₀ ><↑ ₁ *> <↓ ₀ >Fo(a)
		THEN	put(Ty(e), Fo(a), [↓]⊥)
		ELSE	abort
ELSE	abort		(7)

Since such pronominals are marked with accusative case (*him-*), they cannot be processed while the pointer resides at a subject node. This is captured by the actions in lines (2)-(3) which abort the processing in case the point where the pointer currently resides is the argument daughter of the ?Ty(t) node. Line (4) instructs the parser to seek a formula value at another argument node of the predicate-argument structure currently being processed. This is achieved by the underspecified modal specification: <↑₀><↑₁*><↓₀>. This specification

¹¹ This lexical specification does not allow for the processing of strings like *Himself_i John dislikes_i*, *Himself_i Mary said that John will hate_i*. If these are strings are taken to be acceptable, then they can be handled in a similar way as with the Japanese reflexive *zibunzisin* in Cann et al. (2005), i.e. by the reflexives introducing specialised metavariables which have to find a replacement at a very local propositional domain at some point after the initial parsing of the pronoun.

describes a path along the tree which allows the parser to take into account any co-arguments belonging to the proposition being developed. Consider the schematic tree below:

(69)



With the pointer at the lowest $?Ty(e)$ node the route described by $\langle \uparrow_0 \rangle \langle \uparrow_1^* \rangle \langle \downarrow_0 \rangle$ allows the parser to seek a formula value at any of the shaded nodes. One step upwards to the mother node ($\langle \uparrow_0 \rangle$) and then another step upwards ($\langle \uparrow_1 \rangle$) followed by a step downwards ($\langle \downarrow_0 \rangle$) realises the specification: $\langle \uparrow_0 \rangle \langle \uparrow_1 \rangle \langle \downarrow_0 \rangle$ which takes us to the node with Formula *b*. This path is included in the underspecified description $\langle \uparrow_0 \rangle \langle \uparrow_1^* \rangle \langle \downarrow_0 \rangle$ appearing in the lexical entry because of the Kleene star attached to the operator $\langle \uparrow_1 \rangle$ which can be interpreted as zero or more repetitions of this step. Alternatively, one step upwards to the mother node ($\langle \uparrow_0 \rangle$) and then two steps upwards ($\langle \uparrow_1 \rangle \langle \uparrow_1 \rangle$) followed by a step downwards ($\langle \downarrow_0 \rangle$) again realises the description: $\langle \uparrow_0 \rangle \langle \uparrow_1 \rangle \langle \uparrow_1 \rangle \langle \downarrow_0 \rangle$ which is a route also included in the underspecified definition $\langle \uparrow_0 \rangle \langle \uparrow_1^* \rangle \langle \downarrow_0 \rangle$ in the lexical entry (again because of the Kleene star). This will take us to the shaded node with Formula *c* which could also be copied at the $?Ty(e)$ node. In fact, the Kleene star in the path description $\langle \uparrow_0 \rangle \langle \uparrow_1^* \rangle \langle \downarrow_0 \rangle$ allows it to also be interpreted as $\langle \uparrow_0 \rangle \langle \downarrow_0 \rangle$ which means that the parser could conceivably copy a formula value already present on the node (Formula *a*) above in the diagram)¹². This option will not

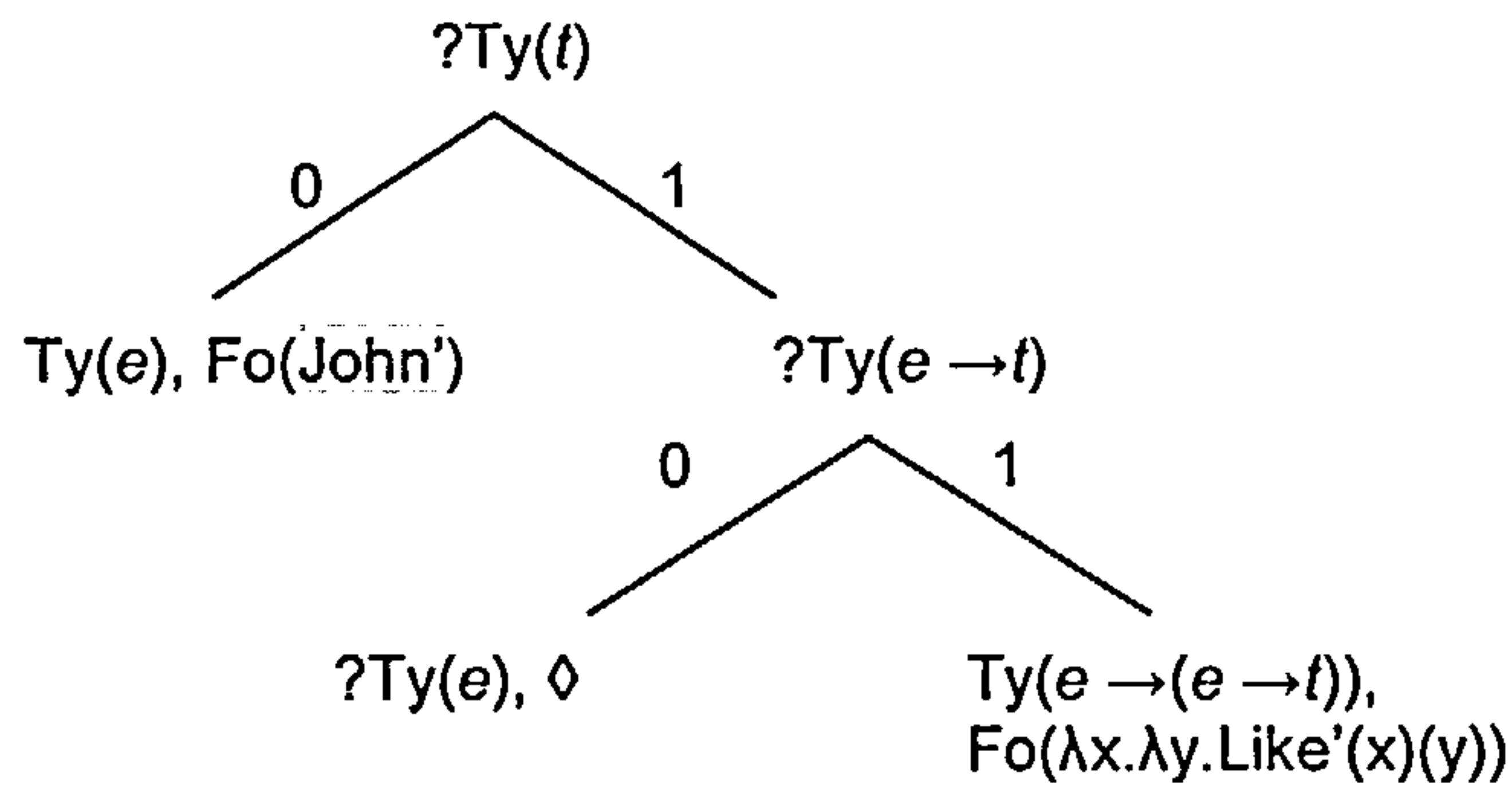
¹² In Cann et al. (2005) this route specification prevents Substitution from applying in cases of *Strong Crossover* configurations by assuming that unfixed nodes unify temporarily with the node under which they are suspended. This formulation is not adopted here.

be utilised here and if one wishes to exclude it explicitly we could employ the slightly longer specification: $\langle \uparrow_0 \rangle \langle \uparrow_1 \rangle \langle \uparrow_1^* \rangle \langle \downarrow_0 \rangle$ (shortened to CA in Kempson et al. 2001).

With this lexical entry the string in (70) below can be processed successfully. The tree shows the parsing stage at which the reflexive pronoun is being processed:

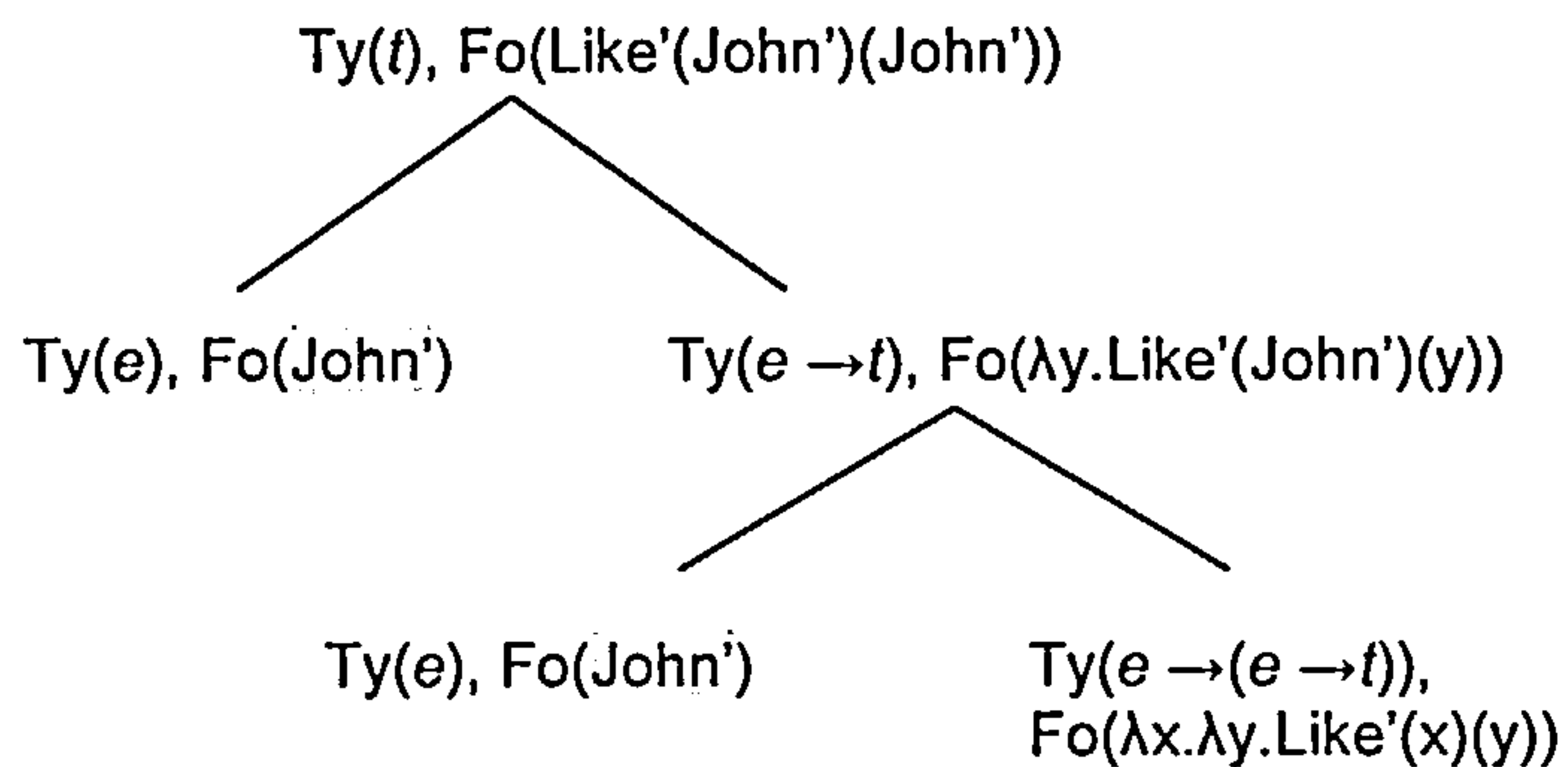
(70) John_i likes himself_i

(71)



The path specification that is needed here to allow copying of the formula value *John'* at the subject node is: $\langle \uparrow_0 \rangle \langle \uparrow_1 \rangle \langle \uparrow_0 \rangle$. Since this path is included in the interpretation of the underspecified description $\langle \uparrow_0 \rangle \langle \uparrow_1^* \rangle \langle \downarrow_0 \rangle$ in the lexical entry for *himself* the parse of the string is predicted to be successful:

(72)



4.e. Pronouns

Strings like the following are excluded by Principle B of Binding Theory which excludes a pronoun from being bound in its local domain:

(73) John_i likes him_i

The procedural equivalent of this restriction is provided by defining constraints on the operation of the process of Substitution. Again we are going to employ the path route description $\langle \uparrow_0 \rangle \langle \uparrow_1^* \rangle \langle \downarrow_0 \rangle$ explicated above which locates the arguments in a predicate-argument structure currently being developed (the co-arguments). By using this description we can specify that a formula value can only be used as a replacement for a metavariable if it is *not* appearing at the point of Substitution at another node in the most local propositional tree, i.e. if it is not a co-argument of the same predicate:

(74) **SUBST**(John')

```

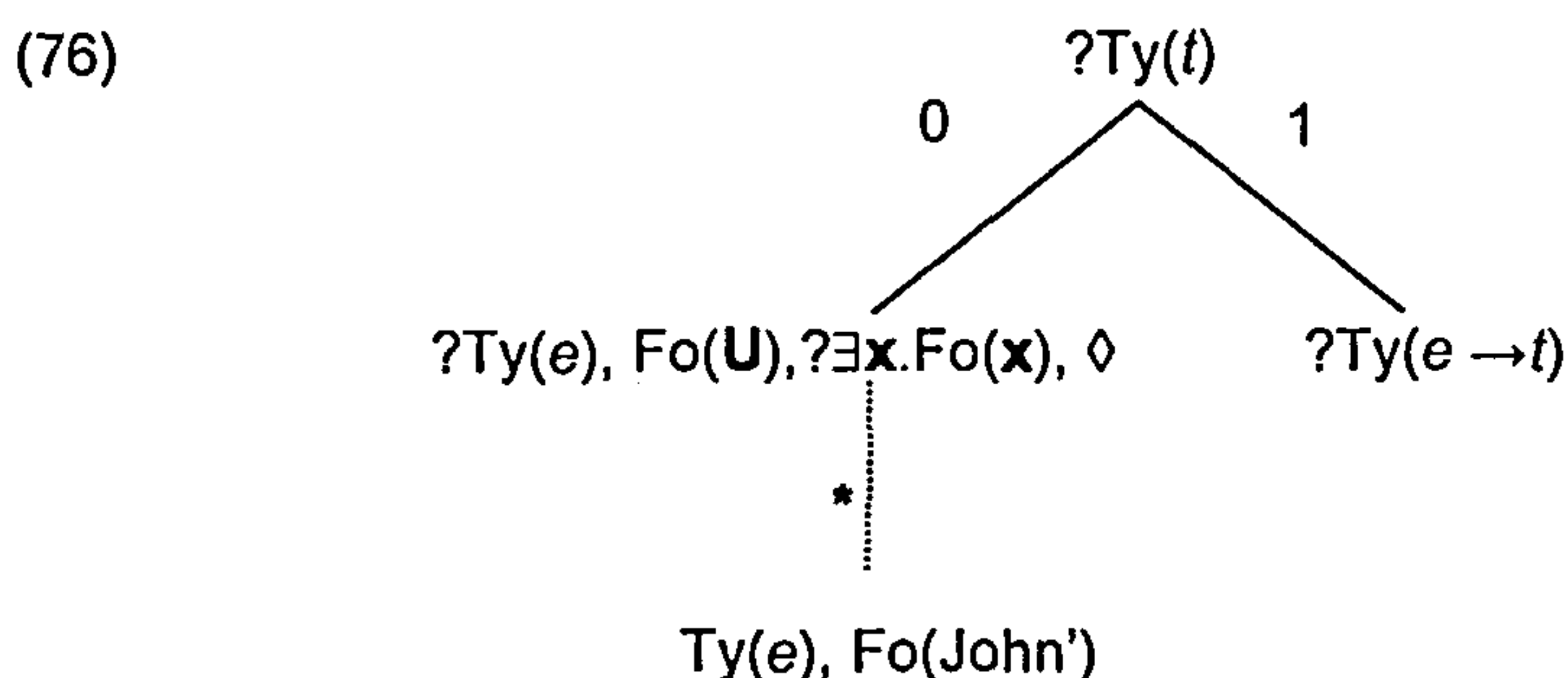
  IF      Fo(U), Ty(e),  $\exists x.Fo(x)$ 
  THEN    IF  $\langle \uparrow_0 \rangle \langle \uparrow_1^* \rangle \langle \downarrow_0 \rangle$  (Fo(John'))
           THEN abort
           ELSE put(Fo(John'))
  ELSE    abort

```

A slight complication arises here because we need to take into account cases like the following where a forbidden formula value replacement is to be found at an unfixed node:

(75) *John_i he_i dislikes

The route description $\langle \uparrow_0 \rangle \langle \uparrow_1^* \rangle \langle \downarrow_0 \rangle$ does not cover this case because we need to be able to look into the unfixed node lying below the current node¹³:



For this reason we will modify the route specification to: $\langle \uparrow_0 \rangle \langle \uparrow_1^* \rangle \langle \downarrow_0 \rangle \langle \downarrow^* \rangle$. This path now covers the case above by interpreting the underspecified

¹³ In Cann et (2005) the previous specification covers these cases because of slightly different assumptions about the *Normal Form Constraint*.

description as: $\langle \uparrow_0 \rangle \langle \downarrow_0 \rangle \langle \downarrow^* \rangle$ which takes us to the unfixed node. According to the rule below the formula value at this node is not available for copying by Substitution¹⁴. We also add the insertion of a requirement that will disallow an identical formula value to become a co-argument in the same predicate argument structure in order to exclude strings like **He_i likes John_i*:

(77) **SUBST**(*John'*)

```

IF      Fo(U), Ty(e),  $\exists x.Fo(x)$ 
THEN IF  $\langle \uparrow_0 \rangle \langle \uparrow_1^* \rangle \langle \downarrow_0 \rangle \langle \downarrow^* \rangle$  (Fo(John'))
      THEN abort
      ELSE put( Fo(John'),  $\neg(CA(Fo(John')))$  )
ELSE abort
      where CA = [ ( $\langle \uparrow_0 \rangle \langle \downarrow_1 \rangle \langle \downarrow_1^* \rangle \langle \downarrow_0 \rangle$ )  $\vee$  ( $\langle \uparrow_0 \rangle \langle \uparrow_1 \rangle \langle \uparrow_1^* \rangle \langle \downarrow_0 \rangle$ ) ]

```

In the tree in (76) above any attempt to substitute *John'* for the metavariable *U* will lead to *abort* which is what we need to exclude the string in (75) (*John_i he_i likes*). These restrictions on Substitution also cover part of what Principle C in Binding Theory is designed to account for in that they disallow a pronoun from c-commanding a coreferential name in the same minimal predicate-argument domain (of course here the notions of “coreference” and “binding” are not appropriate). However, the same Principle is assumed to be needed in order to exclude strings like the following:

(78) *He_i said that John_i is happy*

However it has been repeatedly pointed out that this pattern should not be excluded by means of the grammatical formalism since structurally similar constructions are in fact grammatical:

¹⁴ In Kempson et al. (2001) the issue is handled slightly differently by making reference to future extensions to the current tree that could result in a formula becoming a co-argument:

SUBST(*John'*)

```

IF { $\neg_c CA(Fo(John'))$ , Fo(U),  $\exists x.Fo(x)$ }
THEN abort
ELSE put(Fo(John'))

```

The connective \neg_c is defined as a negation that refers to any extension of the current node that could result by means of computational actions. $\neg_c CA(x)$ is an abbreviation for: $CA(x) \rightarrow_c \perp$, i.e., if $CA(x)$ is the case then the node can only be computationally extended to \perp . The symbol \perp is a proposition that necessarily does not hold at any node in the model. Therefore such an extension will be impossible. This proposition therefore excludes $CA(x)$ from all computational developments of the current tree-node. Note that the usage of the abbreviation CA above is distinct.

- (79) He_i did what John_i always does (*from Sag 2000*)
- (80) The teacher warned him_i that in order to succeed Walter_i was going to have to work a lot harder from now on. (*ibid*)
- (81) It was rather indelicately pointed out to him_i that Walter_i would never become a successful accountant. (*ibid*)
- (82) If you try to tell him_i that the reason why John's_i dog was taken away from him was rabies, he'll get very upset. (*ibid*)
- (83) I've never been able to explain to her_i that Betsy's gophers destroyed my lawn each spring. (*ibid*)
- (84) She_i was told that if she wanted to get anywhere in this dog-eat-dog world, Mary_i was going to have to stepping on some people. (*McCray 1980: 331*)
- (85) She_i was told that the company needed Mary_i. (*McCray 1980:334*)
- (86) She_i was told that under no circumstances would Mary_i have to compromise herself. (*ibid*)

Since we do not want to exclude the above, we can attribute the apparent unacceptability of strings like the one in (78) to pragmatic factors. Use of a pronoun presupposes that there is an accessible term in the context so that Substitution can operate immediately. Violations of this pragmatic (soft) constraint leading to Substitution delay can occur in order to derive contextual effects. If there is no need for a contextual effect-inducing delay, then the string out of context might look unacceptable. This is the case for the string in (78) and therefore we need not exclude it by making provisions in the grammar. As required, the DS rules formulated above will allow all the above, (79)-(86), to be processed successfully since the pronouns occur, not as part of the minimal predicate-argument structure, but embedded inside the propositional argument of a verb. This means that while the metavariable contributed by the pronoun can be left unsubstituted initially, during Completion and Elimination, the pointer by Anticipation will have the chance to revisit the node occupied by the metavariable and substitute it if a value has become available.

Having introduced now an appropriate replacement for the Binding Theory we can examine how the data presented by Iatridou (1991), Bhatt & Pancheva (2001) and Chierchia (1995) can be reinterpreted in DS terms.

5. Conditionals and Binding Conditions

5.a. Cataphoric effects

The main argument against a theory of anaphora that makes crucial use of the linear order of terms in a sentence is that such a theory cannot account for data like the following:

(87) If John_i is happy, he_i smiles.

(88) If he_i is happy, John_i smiles.

(89) *He_i said that John_i is happy.

The contrast between (88) and (89) is taken as evidence that c-command rather than linear order is the relevant factor accounting for such grammaticality contrasts. But, as we have just seen above, this claim cannot be sustained since there are a lot of counterexamples to a syntactic grammar-internal Principle C restriction which will exclude (89). On the other hand, data like (88) do pose a problem for processing accounts like DS and DRT where the explication of anaphora relies on the timing of the introduction of terms in the structure and replacement of variables or metavariables contributed by pronouns. The claim that such data are real counterexamples has not gone unchallenged since it has been argued that most such cases are cases where the individual referred to by use of the proper name has been made salient in the context by some other means, e.g. previous linguistic reference. Therefore the pronoun in the protasis does not rely on the name in the apodosis in order to acquire a referent (see Bolinger 1979, cf. Cann & McPherson 1999). However, even if this claim is true, there are examples involving quantificational phrases which cannot be handled in this way. Below are some constructed examples and examples from the literature:

(90) If he_i is happy, a friend of mine_i smiles.

(91) If he_i is late a man_i will start making excuses

(92) If he_i is upset a friend of mine_i goes to the pub

(93) If a friend of mine_i is upset he_i goes to the pub

(94) A friend of mine_i goes to the pub if he_i is upset

(95) *He_i goes to the pub if a friend of mine_i is upset

- (96) If he_i has a boring wife, a man_i should find a mistress
(from *Reinhart 1983: 116*)
- (97) If he_i lies to a student_k, a teacher_i loses his_k trust (from *Chierchia 1995*)
- (98) If it_i is well-cooked, a hamburger tastes good. (*ibid*)

It could be claimed that all the above involve either *specific indefinites* (see e.g. Fodor and Sag 1982) or generics. Therefore they cannot be taken as counterexamples since they are in some way referential and can receive the same treatment as examples involving proper names as in (88) above. However, first of all, the claim that there is a discreet type of indefinites which can be characterised as “specific” is strongly disputed by DS which is committed to an avoidance of positing ambiguity in favour of underspecification of content (see Kempson et al. 2001:ch. 8; for counterarguments against a distinguished type of nominals that can be characterised as “generics” see Papafragou 1996). Secondly, even if one could invoke ambiguity of indefinites, the problem is not solved because, although less frequent, there are cases of cataphoric effects involving, for example, universal quantifiers. The following are examples from the literature:

- (99) Every mother_i is upset if her_i child is late from school (from *Iatridou 1991*)
- (100) If her_i child is late from school every mother_i is upset (*ibid*)
- (101) Wenn sein Chef glücklich ist, so ist jeder Angestellteri auch glücklich.
when his_i boss happy is so is every office-worker also happy
When his_i boss is happy, every office-worker_i is happy too.
German from (Shaer & Frey 2003)

And the following are attested examples culled from texts found on the web (see Appendix 3 for sources and context):

- (102) Even if she is not working, every mother needs a break from her kids.
- (103) Even if she surrendered her child of her own free will, every birth mother is left with a sense of emptiness and loss -- if not regret and resentment -- for it's impossible to "forget and go on as if it never happened."
- (104) Product Description: It doesn't matter if she's 5 or 105, every female LOVES these rich, thick feather boas.
- (105) By the same token, if Jihad renders every American fair game, then, by virtue of his ongoing intention to commit murder, every Jihadist has also foregone his right to life.

The following is a quote from Dudman (1991):

- (106) If ordinary people are allowed to have any, it would be no surprise to find their metaphysical apprehensions enshrined in their forms of speech.
Dudman (1991: 203)

The problem that these sentences pose is that, according to DS assumptions, the processing of quantificational terms like *a man*, *every mother*, etc. relies on the introduction of a fresh variable in the structure (otherwise we could not prevent accidental bindings of variables by quantificational binders). Pronominals, on the other hand, rely for their interpretation on the presence of a term in the Discourse Context which will provide a copy to replace the metavariable introduced by the pronominal. When a pronoun is encountered during the processing of the sentence-initial *if*-clause in the examples above, there is no replacement available since the quantificational term has not been parsed yet. However, when the quantificational term is encountered later on the pointer has left the LINKed tree which, we have assumed, the content of the *if*-clause occupies. The pointer, according to current assumptions, will not have the chance to return to this tree and the metavariable will remain without a replacement causing the strings to be characterised as ungrammatical. Therefore, for an interpretation of such pronominals as dependent for the substitution of their metavariable on the introduction of the quantified term, we must set up a delaying strategy.

Conditionals are not the only domain where such delayed substitutions can occur. Most adverbial clauses allow this pattern (the following examples are from Reinhart 1983):

- (107) In his_i own way however, each man_i is petitioning for the same kind of administration
(108) As its_i major source of income, each club_i collects a playing fee from the players every half hour
(109) Near his_i child's crib nobody_i would keep matches

Therefore the delaying mechanism operating here does not seem to be an ad hoc device reserved for conditionals only. Moreover, other anaphoric phenomena seem to allow this delay too. VP-ellipsis is analysed in DS as the introduction of a metavariable whose subsequent replacement makes use of

tree structure available in context. The following shows that ellipsis resolution can also be delayed:

- (110) ... If you haven't *done so* yet, we recommend *you read the tutorial*. (from an instruction page on the web)

In fact a delaying mechanism is already needed because of the cases of *Reconstruction*. As we saw earlier, “the so-called “reconstruction effects” are simply a large class of apparent counter-examples to the c-command relation” (Barss 2003: 672).

- (111) Which picture that *he* dislikes did *every student* try to hide?
The one with his girlfriend
- (112) Pictures of herself_i, Mary_i would never buy. (from Culicover 1996:452)
- (113) Herself_i, Mary_i would never endanger. (*ibid*)
- (114) Herself_i, Mary_i says she_i would never endanger. (*ibid*).
- (115) His_i mother, every man_i loves. (from Jacobson 1999)
- (116) His_i mother, I heard that no man_i loves. (*ibid*)

It has been suggested in Cann et al. (2002) that cases like the one in (111) can be handled by the already present delaying mechanism provided by DS, namely the device for introducing and resolving unfixed nodes. They propose the following rule which allows the substitution of a metavariable contained inside an unfixed node when a suitable replacement has been found:

- (117) ***Reconstruction**

$$\frac{\{ \langle \uparrow_\star \rangle T_n(X), \dots Fo(a[\mathbf{U}]), \dots \}, \dots \{ (MOD)T_n(X), Fo(\beta), Ty(Y), \diamond \} \}}{\{ \{ \langle \uparrow_\star \rangle T_n(X), \dots Fo(a[\beta]), \dots \}, \dots \{ (MOD)T_n(X), Fo(\beta), Ty(Y), \diamond \} \}}$$

where $MOD \in \{ \langle \uparrow_0 \rangle, \langle \uparrow_1 \rangle \}^*$

Since the analysis of conditionals that we have provided here allows them to be parsed as LINK structures attached to unfixed nodes it will be natural to assume that the treatment of *Reconstruction* phenomena proposed above extends to conditionals too. We thus assume that such cataphoric phenomena are associated with the processing of unfixed nodes which, exceptionally, can support delays in the substitution of metavariables. We will use a slightly different treatment here presented in Gregoromichelaki (2003)

because we believe that it is more incremental and models the anaphoric resolution as soon as a value has become available more accurately.

5.b. Substitution Delay

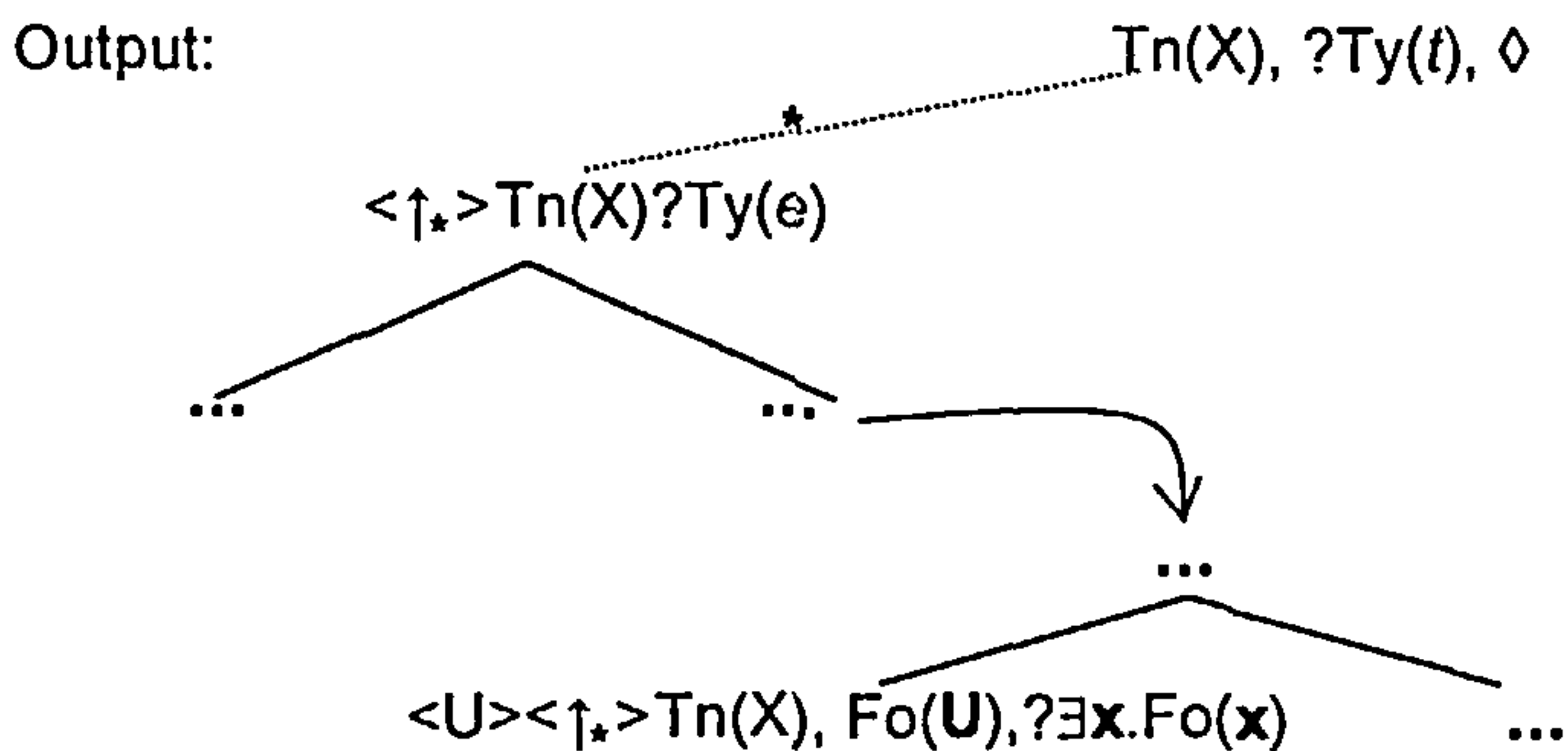
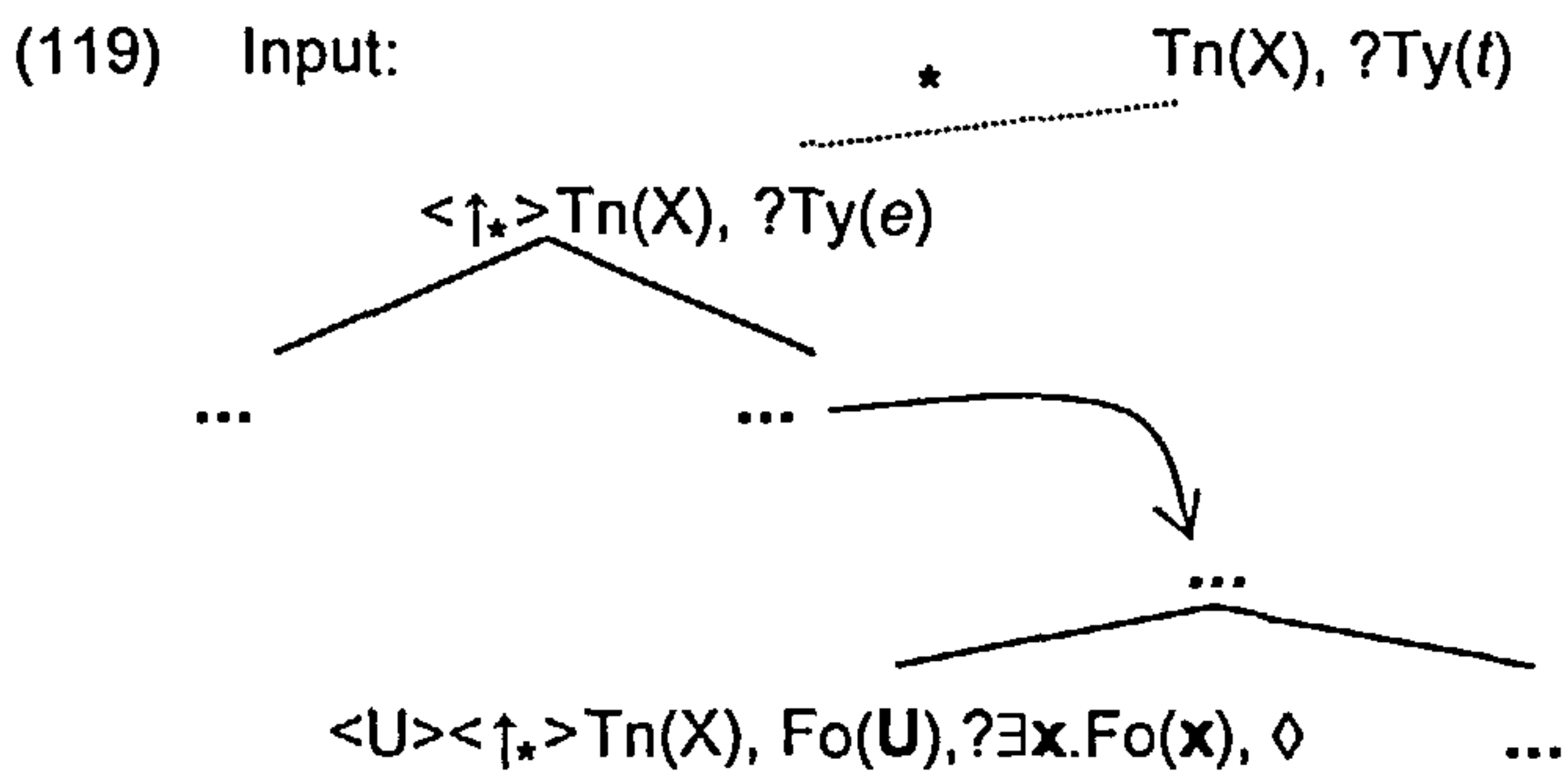
DS defines an unfixed node as a tree branch whose exact position on the tree will be resolved at some later time after its initial construction. This resolution is effected by the operation *Merge* which collapses a fixed node bearing the pointer and a “compatible” unfixed node. For this collapse to be implemented most locally when appropriate conditions obtain, an unfixed sub-tree will be carried down the tree, always hanging below any node currently under development (the *Normal Form Constraint*, see Kempson et al. 2001: 277). Merge can be attempted from every node under which the unfixed sub-tree is suspended with general “compatibility” constraints resolving whether the operation will be successful or not.

For the explanation of the cataphoric cases, the only stipulation that we need to introduce is that, during the completion of an unfixed sub-tree, the parser is allowed, as an alternative route, to defer fully completing its decoration and return to the node from which the underspecified dominance relation is defined. This move should be restricted to occur only during the construction of an unfixed node because this is the only case where the pointer will be allowed to return to the point at which processing was abandoned. The rule below defines the movement of the pointer from a node embedded into an unfixed node to the topmost node of the sub-tree under construction where the unfixed relation originates:

(118) *Pointer movement under Reconstruction*¹⁵

IF $\langle U \rangle \langle \uparrow_* \rangle (\text{Tn}(\mathbf{x}) \wedge ?\text{Ty}(t)), \text{Fo}(\mathbf{U}), ?\exists \mathbf{x}.\text{Fo}(\mathbf{x})$
THEN **IF** $\langle \uparrow_0 \rangle \langle \downarrow_1 \rangle ?X$
 THEN abort
 ELSE $\text{go}(\text{Tn}(\mathbf{x}) \wedge ?\text{Ty}(t))$
ELSE abort

Below is a schematic illustration of the input and the output of the rule:



The only reason that such an incomplete structure will not eventually give rise to ill-formedness is that the pointer will be able to return to the undeveloped nodes as a side-effect of subsequent essential parsing steps. As we will see below, these steps crucially involve attempts for the execution of Merge when two nodes, one fixed and the other unfixed, are being tested for merge-compatibility.

¹⁵ The appropriate formulation of this rule has benefited by a crucial suggestion by Ronnie Cann (pc.).

In the cases of interest, where an unfixed tree branch contains a metavariable and has therefore remained incomplete, none of the non-terminal nodes above the node with the metavariable will have either Formula or Type values, awaiting as they do a proper value to replace the metavariable. In that respect what we seek to model is the sense in which such incomplete unfixed subtrees constitute a “liability” for the parser which will attempt to resolve them at any available opportunity. In order to do that, we will link the completion of such structures to the *Normal Form Constraint*, which also characterises a notion of “liability” for the unfixed node, and the operation of Merge.

We will assume that if the option to attempt Merge is taken up at any point in the parse while the unfixed branch is still incomplete, then the pointer will be required to return to the “open” node and attempt its completion. If, during one of these returns to the metavariable-decorated node, the appropriate value has become available, then Substitution of the metavariable can occur and the entire unfixed subtree can be completed as a consequence. Because of the (modified) rule of *Completion* the pointer is then licensed to return to the fixed node from which Merge was attempted. For illustration consider the string in (100) repeated below¹⁶:

(120) [Which of the pictures that he_i dislikes] did every student_i try to hide?

An unfixed node carrying a LINKed sub-tree constructed by processing the left-dislocated phrase (*which of the pictures that he dislikes*) will be initially introduced but will remain incomplete because of the unavailability of a replacement for the metavariable contributed by the pronoun *he*. The pointer

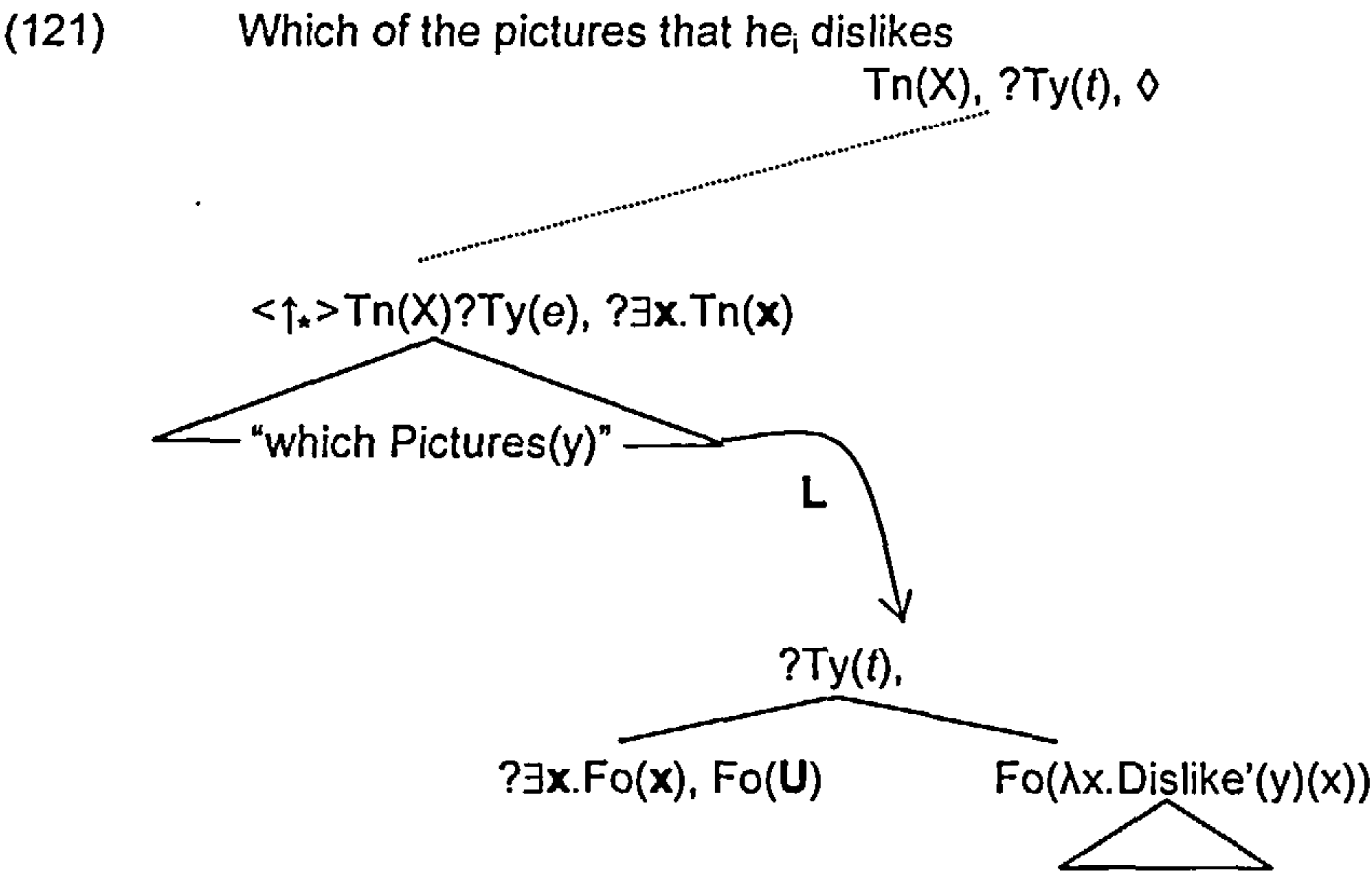
¹⁶ The system will apply without modification to multiple occurrences of pronouns in the reconstructed part, and furthermore, there is no locality restriction between the two antecedent-sites:

(i) Which picture that she had taken from him did each boy decide that his mother didn't need to return?

(ii) Which picture that he had given to her did each painter try to insist that his sponsor return to him?

(iii) Which picture that she had taken from him did each boy decide that a friend of his could keep?

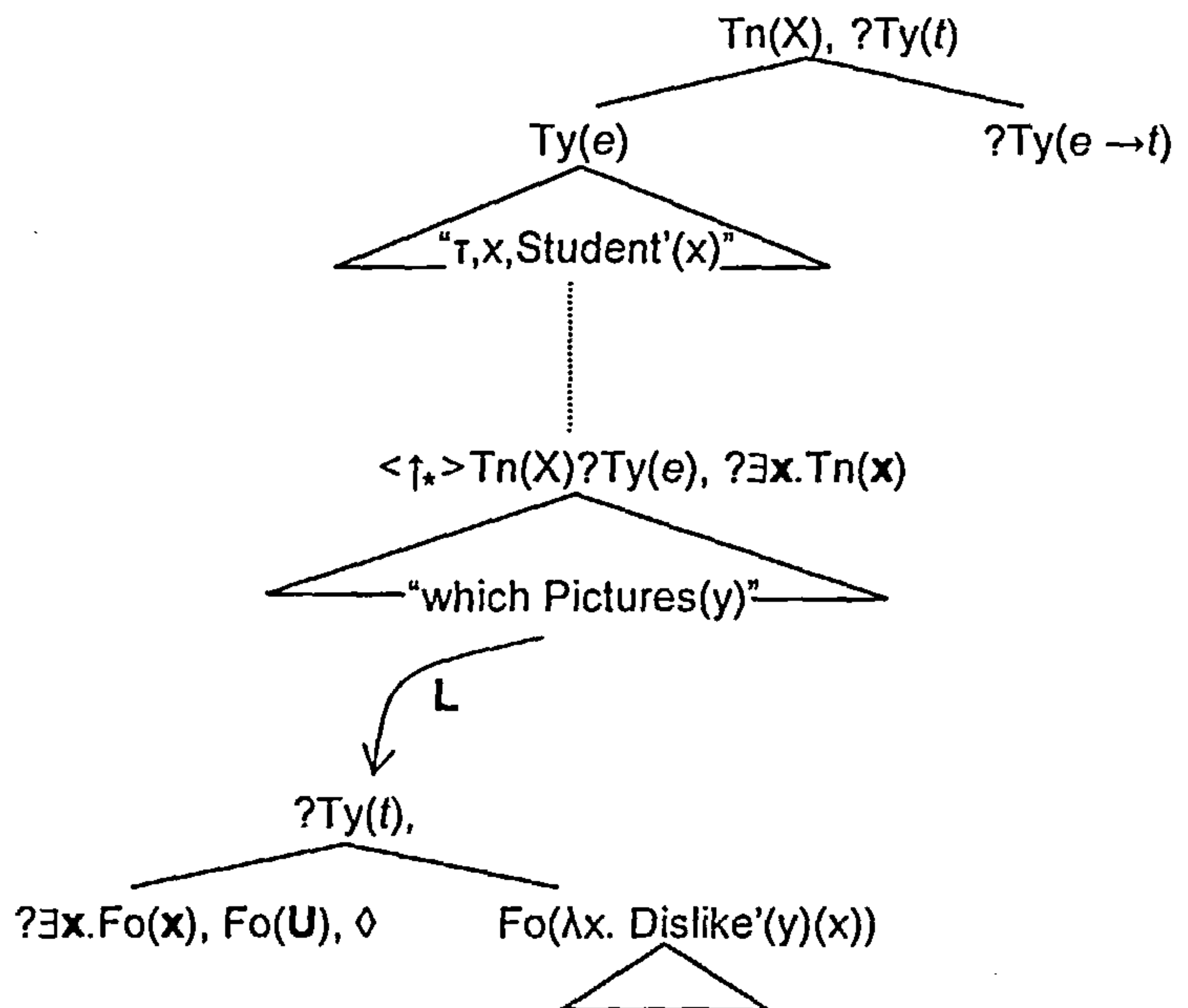
will be allowed to return to the root node of the tree under construction because of the rule in (118). The following schematic diagram depicts the tree at the stage at which processing of the $?Ty(e)$ unfixed node has been abandoned and the pointer has returned to the $?Ty(t)$ node:



According to the *Normal Form Constraint* the unfixed subtree will hang below each node being processed following the pointer¹⁷. Merge can be attempted at each such node. As a result, when Merge is attempted at the Subject node whose formula value has been derived by parsing the phrase *every student* the modified rule for Merge that we define below will cause the pointer to move to one of the nodes inside the LINKed tree where the unsubstituted metavariable can be found. Below we depict the stage at which the phrase *every student* has been processed and the pointer moves inside the unfixed subtree to substitute the metavariable:

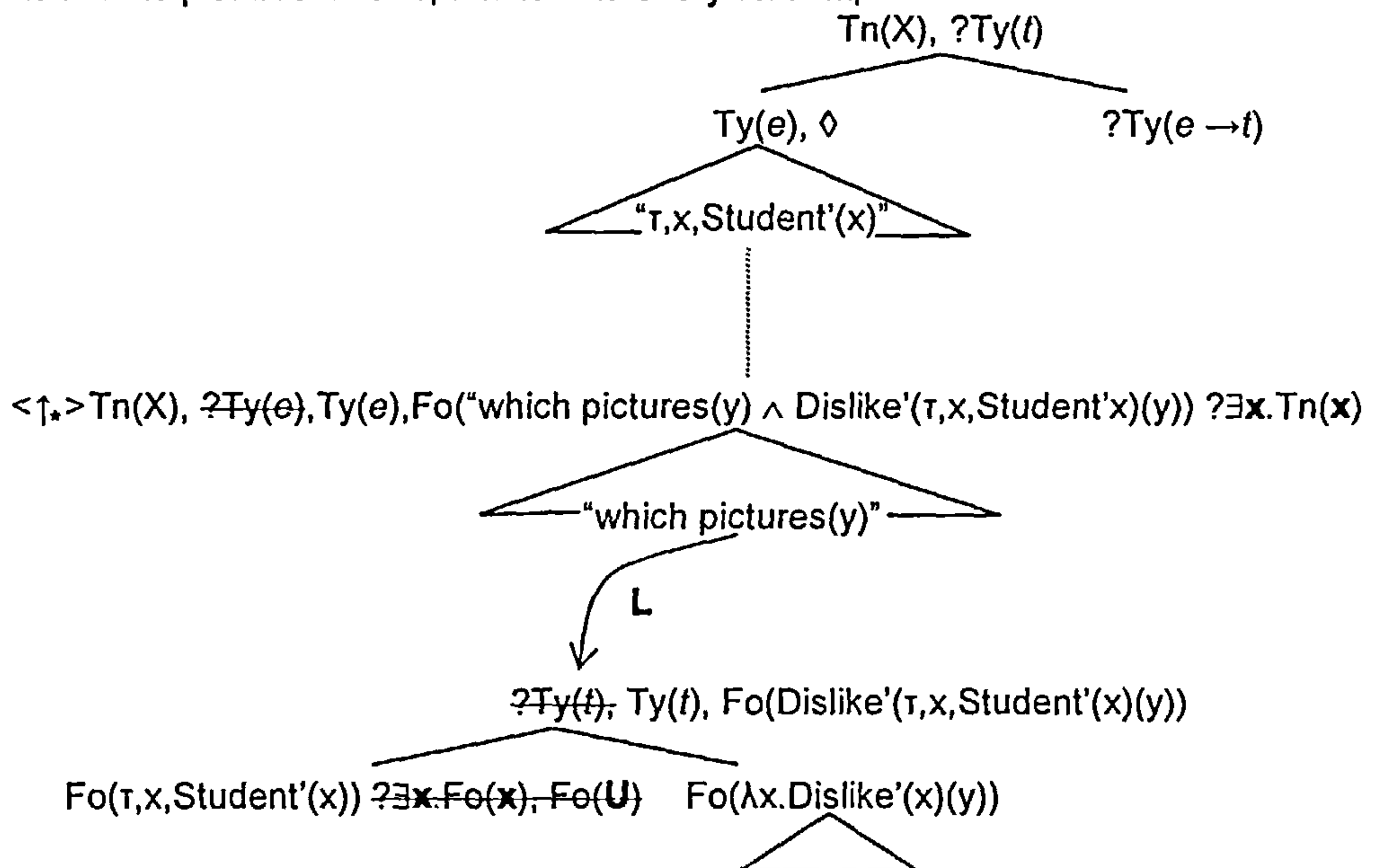
¹⁷ Note that we assume here that the unfixed node always hangs underneath the node at which the pointer resides, which would not necessarily be the lowest node on the tree. That the unfixed node follows the pointer is essential for Merge to be attempted at each node.

(122) Which of the pictures that he_i dislikes did every student_i



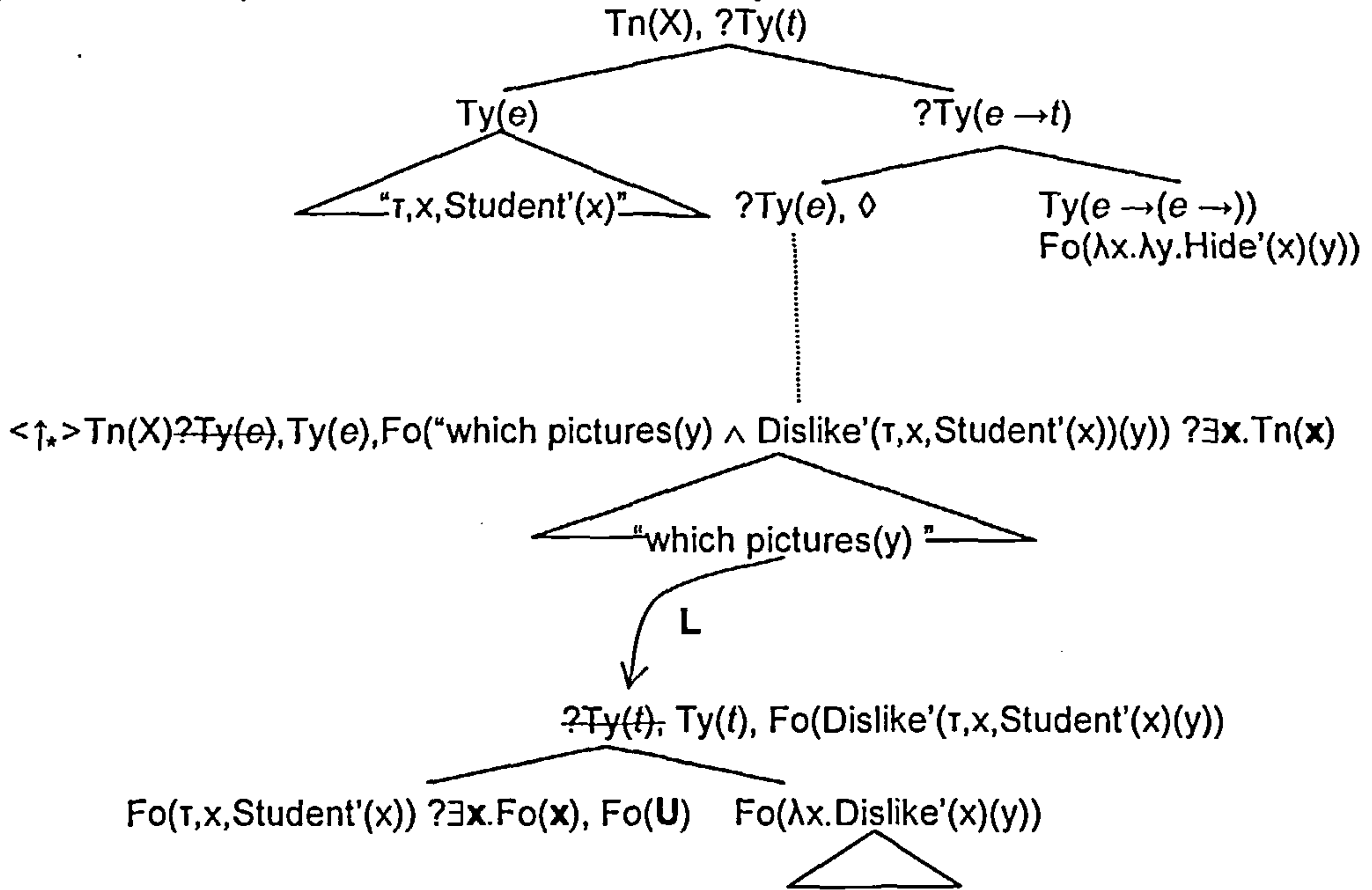
Having a value for this metavariable available now due to the processing of *every student*, Substitution can occur and the entire unfixed subtree can be completed as usual. The rule of Completion will return the pointer to the node from which Merge was attempted:

(123) Which of the pictures that he_i dislikes did every student_i



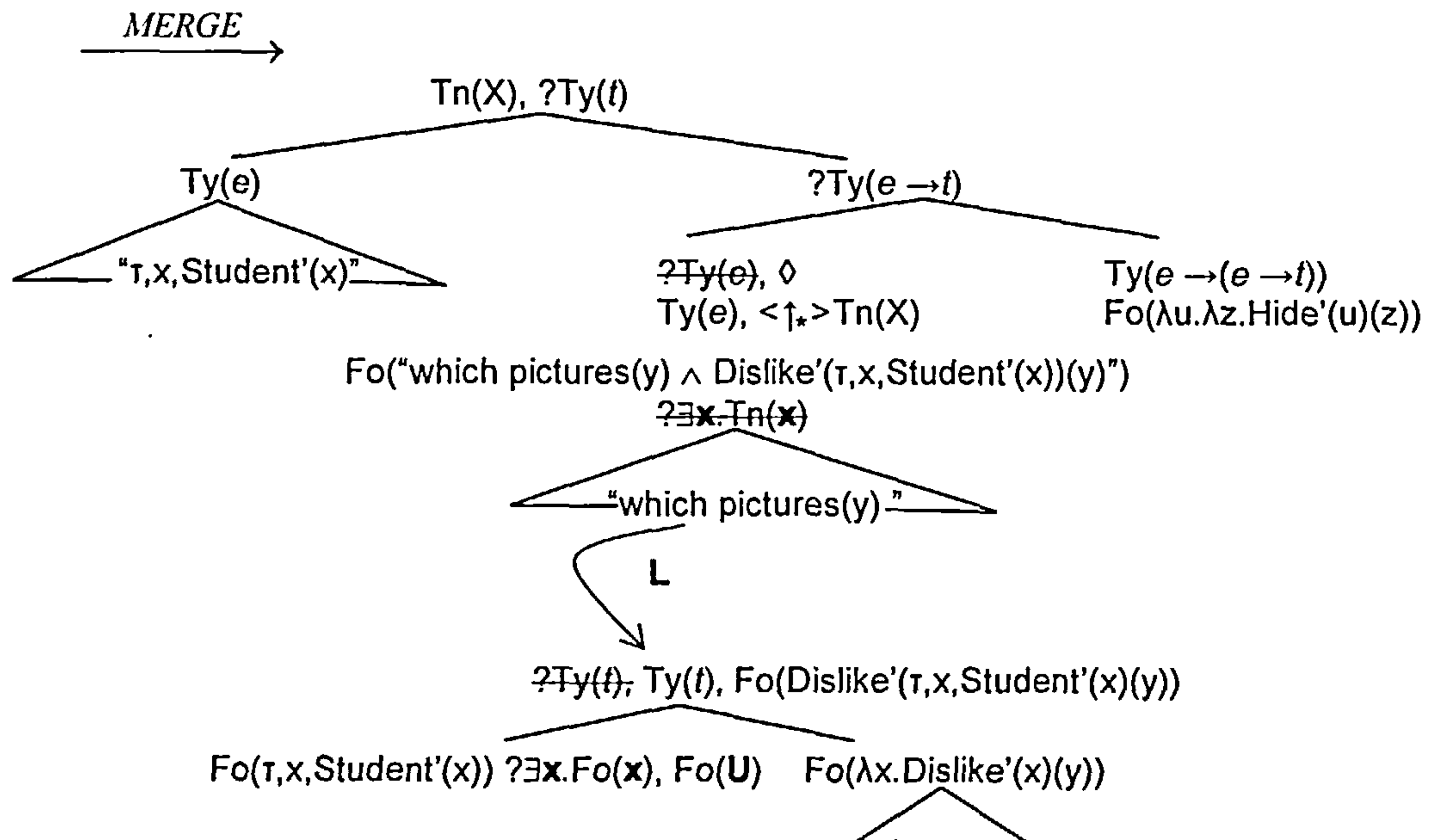
Merge can be attempted again but it will be unsuccessful because of the incompatibility of the distinct Formula values decorating the two nodes. However the unfixed subtree is now complete and, as soon as the Direct Object node has been constructed Merge can again apply and now successfully collapse the two nodes¹⁸:

(124) Which of the pictures that he_i dislikes did every student_i hide



¹⁸ We have condensed the string to "Which of the pictures that he disliked did every student hide?"

(125) Which of the pictures that he_i dislikes did every student hide



Now, in order to be able to define this process formally we need to be a bit more explicit about how Merge operates. First of all, we need to give a simplified definition of the consistency check which tests whether two nodes are compatible for Merge (see Kempson et al. 2001: 324-325 for the exact details). This is performed by employing the formula *NOMERGE* defined below:

(126) $NOMERGE = \vee \{ \exists xy (DU_i(x) \wedge <\downarrow_*> DU(y) \wedge \neg(DU_i(x) \wedge DU(y)) \}$
 where *DU* stands for sets of decorations on a node and *DU_i* for the set of the decorations on the node at which the pointer is located

The formula *NOMERGE* holds at a node if some of its decorations are incompatible with the decorations of a node dangling below it. For example, it could be that the fixed node is of $Ty(e \rightarrow t)$ and the dangling node is $Ty(e)$. If this is the case then *NOMERGE* holds at the $Ty(e \rightarrow t)$ node. The definition of Merge in Kempson et al. (2001) employs the formula *NOMERGE* inside the definition of the rule for Merge in order to make sure that merging of two nodes is only possible when they carry compatible decorations (remember here that Computational Rules might be presented in a condensed form as

input and output tree descriptions but they do in fact consist of the same types of actions that are employed in lexical actions; we employ the explicit format here in order to be able to modify the definition of the rule):

(127) **Merge**

```

IF  <↓*> T
THEN IF      ↓ T ∨ NOMERGE
      THEN  1
      ELSE  merge
ELSE  abort

```

This rule says that if there is a dangling daughter at the current node then no action will be taken (symbolised by 1 above) in case one of the following two conditions hold: (a) either the fixed node has a daughter already or (b) *NOMERGE* holds at the node, i.e. if the fixed node has decorations incompatible with those at the unfixed node. Otherwise (**ELSE**) the action *merge* will be performed.

What we need to do now is to modify the definition of Merge so that when an unfixed node is considered for merging with a fixed one, if there is an unresolved metavariable inside the suspended node, then the pointer can move directly at that node where the metavariable resides. The modified rule is as follows:

(128) **Merge** (*modified*)

```

IF  <↓*> T
THEN IF    ↓ T
      THEN 1
      ELSE IF  <↓*><D>Fo(U), ?∃x.Fo(x)
                THEN go(<↓*><D>Fo(U), ?∃x.Fo(x))
                ELSE IF    NOMERGE
                        THEN 1
                        ELSE merge
ELSE abort

```

As previously the rule first checks whether the current node has an unfixed daughter. If this is the case it then checks whether the node has a fixed daughter already. If this is true then nothing will change (1). If it is not true, then a check is performed to see if there is a metavariable awaiting Substitution inside the subtree associated with the unfixed node. Note that the modality <D> can look into both dominated and LINKed nodes. If such a metavariable is found the pointer will be moved there and the usual parsing rules will take over in case there is a replacement available for the metavariable at this point. On the other hand, if there is no unreplaced metavariable inside the unfixed subtree the consistency check will be performed by the formula *NOMERGE* and, if it is successful, merging of the two nodes will occur. Note how conducting the consistency check performed by employing the *NOMERGE* formula becomes conditional on having resolved any unreplaced metavariables. This is natural in this context since, if the unfixed subtree has remained incomplete, the consistency check will not give results that can be maintained later in the parsing process, thus threatening the monotonic nature of the task (for example since an incomplete unfixed subtree has no Formula value and still requires a fixed position, it could merge with a completed node which provides such fixed

values: “*Which of his pictures that every student dislikes Mary”). In case the rule applies and there is still no Formula value available for the metavariable inside the unfixed subtree the pointer movement rule in (118) (in conjunction with Anticipation) will be able to return the pointer to the fixed node again.

We are almost there. The only thing remaining is to also modify the *Completion* rule from Cann et al. (2005) repeated below:

(129) **Completion**

$$\frac{\{...\{ Tn(n), ...\}, \{ <\uparrow_i>Tn(n), ..., Ty(X), ..., \Diamond \} \}}{\{...\{Tn(n), ..., <\downarrow_i>Ty(X), ..., \Diamond\}, \{<\uparrow_i>Tn(n), ..., Ty(X), ..., \} \}}$$

where $i \in \{0, 1, * \}$

We have to modify this rule because we do not want the movement of the pointer from the (completed) unfixed node dangling underneath a fixed node it is not going to merge with to cause the insertion of a decoration at the fixed node stating that the unfixed node will remain dominated by its current mother ($<\downarrow_i>Ty(X)$). This might cease to be the case if Merge is not performed at that point. Therefore we have to split the *Completion* rule into two separate rules, one for movement of the pointer from unfixed nodes to fixed nodes and another one for the remaining cases:

(130) **Completion (fixed nodes)**

$$\frac{\{...\{ Tn(n), ...\}, \{ <\uparrow_i>Tn(n), ..., Ty(X), ..., \Diamond \} \}}{\{...\{Tn(n), ..., <\downarrow_i>Ty(X), ..., \Diamond\}, \{<\uparrow_i>Tn(n), ..., Ty(X), ..., \} \}}$$

where $i \in \{0, 1\}$

(131) **Completion (unfixed nodes)**

$$\frac{\{...\{ Tn(n), ...\}, \{ <\uparrow_*>Tn(n), ..., Ty(X), ..., \Diamond \} \}}{\{...\{Tn(n), ..., \Diamond\}, \{<\uparrow_*>Tn(n), ..., Ty(X), ... \} \}}$$

The two rules now allow movement of the pointer out of an unfixed subtree without having to decorate the fixed node with anything recording the presence of the unfixed node. So as soon as an unfixed subtree has been

completed the pointer will be allowed to freely return to the node located immediately above it.

This completes our discussion of Reconstruction effects and their proposed DS treatment. We illustrated the modifications to the framework with an example involving a left dislocated *wh*-phrase but exactly the same analysis can be given for *if*-clauses containing pronouns that depend on quantificational terms that will be introduced later:

(132) If her_i child is late from school every mother_i will be upset.

This is because we have assumed that the content provided from such clauses also decorates unfixed nodes. Such unfixed subtrees containing metavariables can also go through a stage of being radically incomplete awaiting an appropriate substitution for the metavariable to be found. As soon as a node of the tree hosting the content of the consequent is able to provide a value for the metavariable inside the unfixed subtree, the pointer by Merge will move inside the incomplete subtree and complete it. The unfixed subtree will then Merge with the situation node at some later stage.

We have also nothing further to say about the treatment of the pronominal binding effects and their procedural explanations as made available by the framework we are exploring here. In the next chapter we will consider other forms of anaphoric resolution that have been claimed to pose challenges for the unified treatment of anaphora advocated by DS. We will examine these phenomena in the context of the proposed analysis for the processing and structure assigned to conditionals and its interaction with the phenomenon of quantificational binding. We will then attempt to see whether we could still maintain a unitary analysis of anaphoric effects.

CHAPTER 8

ANAPHORA AND QUANTIFICATION IN CONDITIONALS

We now turn to examine the interaction between the analysis of anaphoric phenomena in DS and the account of quantification as it applies in the domain of conditionals. We will first review other approaches, point to certain problems and then present an alternative view of the issues that arise.

1. The Resolution of Anaphora and Quantification

Geach (1962) argued that pronouns in natural languages can be treated as the *bound* variables of a predicate logic language¹. This would seem to be a justified assumption if only single sentences are taken into account. For example, the pronoun *he* below can be interpreted as the variable *x* bound by the universal quantifier introduced by *every*:

- (1) *Every man thought he was happy*
- (2) $\forall x. \text{Man}(x) \rightarrow \text{Thought}(x, \text{Happy}(x))$

Problems for this assumption were pointed out subsequently. Pronouns do not always appear inside the scope of the operators that supposedly bind them (see e.g. Evans 1977, 1980²):

- (3) A man_i was happy. He_i was going home.
- (4) If a man_i is happy he_i is going home.

Resolution of these problems has been taken to involve an account of the context in processing discourse rather than simply appealing to the structure of isolated sentences. As one of our concerns here is to define how interpretations are built up dynamically (as far as conditional sentences are concerned) we will have to examine the issue of the resolution of so called *unbound anaphora* cases which arises very critically in this domain. We will

¹ Geach also suggested that there are also *pronouns of laziness* standing for linguistic expressions.

² As reported in the literature, the issue of *donkey sentences* is far older than modern formal treatments since it goes back to Stoic philosophical inquiries.

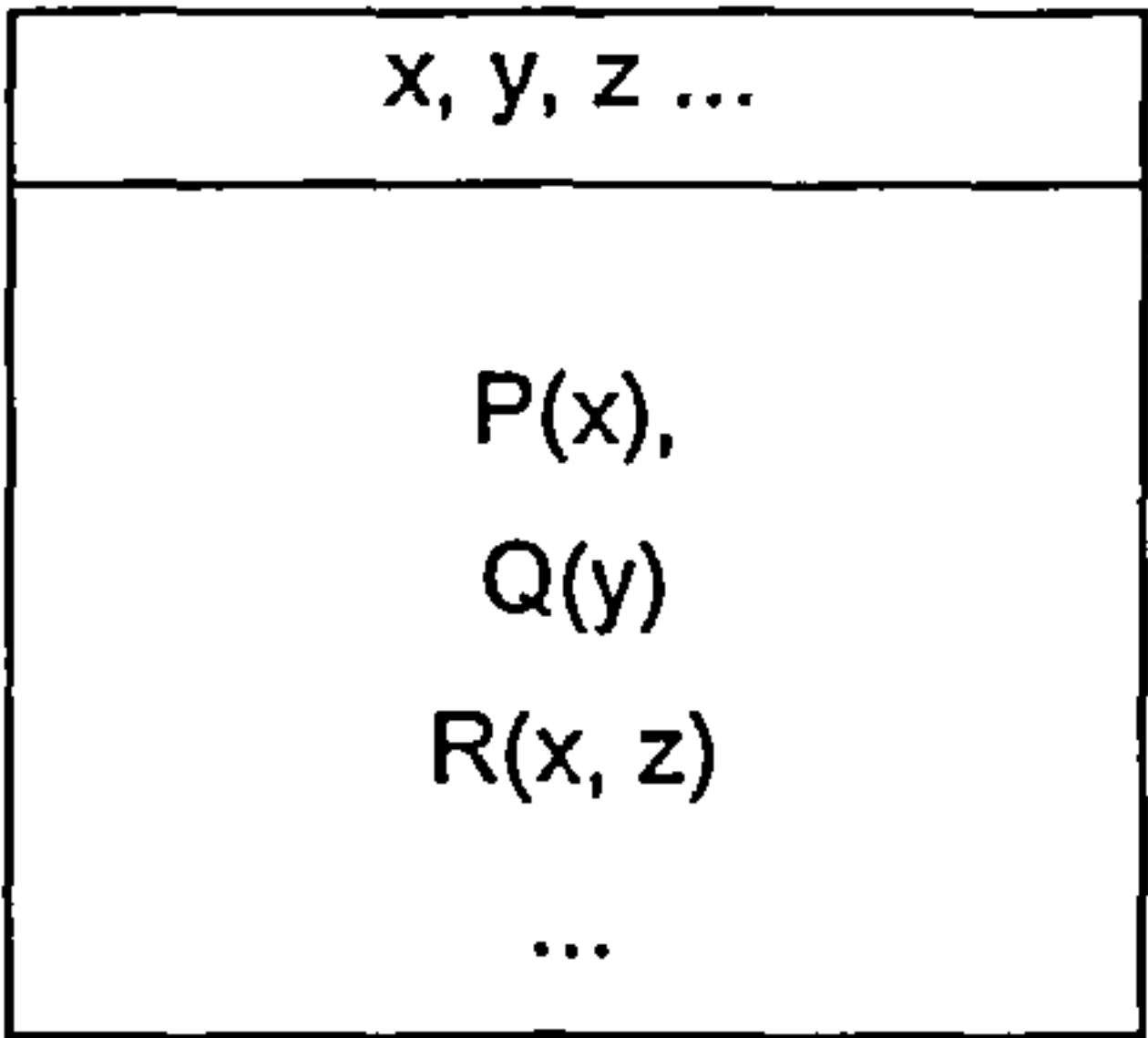
first see how classical *Discourse Representation Theory* (DRT), *Dynamic Semantics* (DPL and Dynamic Binding) and the *Situation* and *E-type* accounts address the issues involved. Then we discuss whether there are any new insights to be gained by taking the DS perspective to these phenomena.

1.a. Classical DRT

DRT (Kamp 1981, Kamp & Reyle 1993, Heim 1982) is motivated by the need to give an account of how the process of interpreting a text or discourse leads to the generation of a representation of its content. The process of interpretation and resulting representation can then provide solutions for syntactic and semantic puzzles. Under the view adopted by Kamp 1981 and Heim 1982, structured natural language strings are taken as the input for rules whose application results in the construction of explicit logical form representations, *LFs*, (Heim 1982) or (descriptions of/constraints on³) partial models reflecting the discourse content (*DRSs*, Kamp 1981). Kamp's (1981) framework is more clearly compatible with present assumptions in that he takes those representations to model mental representations. Therefore we will mainly concentrate on that account pointing out parallels with Heim's approach. Kamp's representationalist stance can be discerned in the intermediate partial model representations (*DRSs*) generated by processing discourse. *DRSs*, are represented graphically in box format. They comprise: (a) a set (*universe*) of variables, *x*, *y*, *z*,..., taken as representations of the entities mentioned in the discourse (*discourse referents*), and, (b) *conditions* which comprise predications on the discourse referents that must be satisfied by the entities corresponding to those discourse referents in the model representing the world.

³ see van Eijk 2005: 10, cf. Kamp 1981: 189

(5)



In DRT not only pronouns are analysed as variables/discourse referents but also indefinite NPs. A DRS universe is populated by the processing of such expressions and the values associated with such referents can be any entities in the model as long as they satisfy the conditions ascribed to them. Definite noun phrases and pronouns are assumed to also introduce such referents. However the latter must be identified with other referents already present in the representation. We shall now see what the motivation is for analyzing indefinites in this way in DRT.

The traditional way of analyzing indefinite NPs is as existentially quantified terms (see, e.g. Russell 1919, Geach 1962), an analysis which is implicitly sustained in syntactic accounts with general application of QR (see e.g. Hornstein 1995) or which invoke ambiguity effects in the interpretation of indefinites (Farkas 1999) or in Generalized Quantifier theory (Barwise & Cooper 1981). According to such an analysis, a sentence like (6) can be interpreted as shown in (7):

- (6) A man loves a woman.
- (7) $\exists x \exists y \text{ Man}(x) \wedge \text{ Woman}(y) \wedge \text{ Loves}(x, y)$

Following initial observations by Lewis (1975), DRT abandons the traditional analysis of indefinites as existentially quantified. This is because in certain environments indefinites seem to assume quantificational forces other than existential. These contexts include generic sentences, the scope of adverbs of quantification and conditionals. Consider the following interpretations of indefinites:

- (8) A woman *seldom* awoke at dawn.
- (9) A woman *always* awoke at dawn.
- (10) A woman *usually* awoke at dawn.

Lewis (ibid) argued that quantificational adverbs like *seldom*, *usually*, *never* etc. can be interpreted as *unselective quantifiers* determining how many value assignments to the free variables in the modified sentence in their scope should make it true. The sentences in (8)-(10) have a reading in which what is stated is that few/most/all women at some past time awoke at dawn. If indefinite noun phrases are consistently analysed in the traditional way as existential quantifiers then this reading cannot be derived without additional assumptions⁴. In DRT this has been taken to imply that indefinite descriptions in general are best analysed as contributing free variables/discourse referents to the semantic representation. In the domain of conditionals similar observations can be made regarding the distinct behaviour of indefinites as compared with referential terms. In (11) below the proper name *Mary* occurs in the antecedent of a conditional. The interpretation of the clause involves considering alternative occasions: namely all the different occasions in which Mary is upset. The reference assigned to *Mary* doesn't change even though it is embedded in this way:

- (11) If Mary was upset, she drank milk.

On the other hand, when an indefinite occurs in the protasis of a conditional it seems to acquire the potential of referring to all the alternative individuals that satisfy the verbal predicate in that sentence. In (12) below we consider occasions in which any donkey whatever might have been upset and drank milk:

- (12) If a donkey was upset it drank milk.

Sentences like the one immediately above are termed *donkey sentences* and exemplify one of the main reasons for the establishment of the DRT analysis of indefinites. Kamp (1981) (among others) observes that donkey sentences

⁴ Lewis (1975) introduced in fact such additional assumptions but these need not concern us here.

like the one in (13) seem to receive interpretations which can be represented with the predicate logic formula in (14):

- (13) If Mary owns a donkey she feeds it
 (14) $\forall x [\text{Donkey}(x) \wedge \text{Own}(\text{Mary}, x)] \rightarrow \text{Feed}(\text{Mary}, x)$

The apparent universal force required in the translation of such indefinites cannot be explained by their traditional analysis as existential quantifiers without further assumptions. Since there is an intimate connection between universal quantification and implication in predicate logic⁵, one way to attempt approaching this phenomenon while maintaining the analysis of indefinites as existential quantifiers would be to attribute the apparent universal force to the logical equivalence between wide scope universal quantifiers and conditionals with an existential quantifier in the antecedent. For example, the formulae shown in (16) and (15) are logically equivalent:

- (15) $\forall x [\text{Donkey}(x) \wedge \text{Owns}(\text{Pedro}, x)] \rightarrow \text{Rich}(\text{Pedro}) \leftrightarrow$
 (16) $[\exists x \text{Donkey}(x) \wedge \text{Owns}(\text{Pedro}, x)] \rightarrow \text{Rich}(\text{Pedro})$

In that respect, it could be claimed that (15) can be taken as a representation of the content of (17) below because of its equivalence with (16):

- (17) If Pedro owns a donkey he is rich

However, Kamp argues, this approach, which is roughly the approach that will be presented here, will not work for the classical donkey sentences. The reason for this is the fact that anaphoric connections can occur between protasis and apodosis. For instance, in donkey sentences like (13) above (repeated below), the apodosis contains a pronominal assumed to be dependent for its reference on the indefinite *a donkey*:

- (18) If Mary owns a *donkey* she feeds *it*

⁵ This connection is somewhat lost in accounts of conditionals as definite descriptions as in e.g. Schlenker (2001), Schein (2001). The connection is also linguistically manifested, for example, by the fact that negative polarity items like *any* can occur in the antecedent of a conditional:

- (i) *I send any letters and I expect them to read them.
 (ii) If I send any letters I will expect them to read them.

If we make the additional assumption that pronouns are translated in the traditional way as free variables, then the logical representation for (18) is given by a predicate logic formula as in (19) below. But this formula does not represent the intuitively correct interpretation because the variable corresponding to the pronoun *it* is free (i.e. not inside the scope of the existential quantifier). Instead the formula in (20) with the wide scoping universal seems to capture more closely the intuitive truth conditions:

(19) $[\exists x \text{ Donkey}(x) \wedge \text{Owns}(\text{Mary}, x)] \rightarrow \text{Feed}(\text{Mary}, x)$

(20) $\forall x [\text{Donkey}(x) \wedge \text{Owns}(\text{Mary}, x)] \rightarrow \text{Feed}(\text{Mary}, x)$

This seems to be verified by the additional observation that sentences with relative clauses modifying a universal quantifier expression as in (22) below and conditionals like (21) seem to involve identical truth conditions:

(21) If a man owns a donkey, he feeds it.

(22) Every man who owns a donkey feeds it.

(23) $\forall x \forall y [\text{Man}(x) \wedge \text{Donkey}(y) \wedge \text{Own}(x, y)] \rightarrow \text{Feed}(x, y)$

Therefore it is proposed that both types of sentences, relatives with universals and conditionals, require virtually identical logical form representations. The indefinites contained in such clauses must somehow acquire universal force rather than the existential semantics predicted by the traditional Russellian account. If we are to avoid translating indefinites sometimes as universal and sometimes as existential quantifiers then the DRT solution of translating them as free variables/discourse referents has to be adopted. Additional confirmatory evidence for this analysis is provided by scope considerations: it seems that if indefinites were to be taken as contributing existential quantifiers they should be allowed to extend their scope in a way not permitted for other bona fide quantifiers, like universals, in order to explain how the pronoun acquires its reference in examples like (24):

(24) A donkey_i came in. It_i is pretty. It_i seems to be hungry. I am going to feed it_i.

(25) #Every donkey_i came in. It_i was hungry.

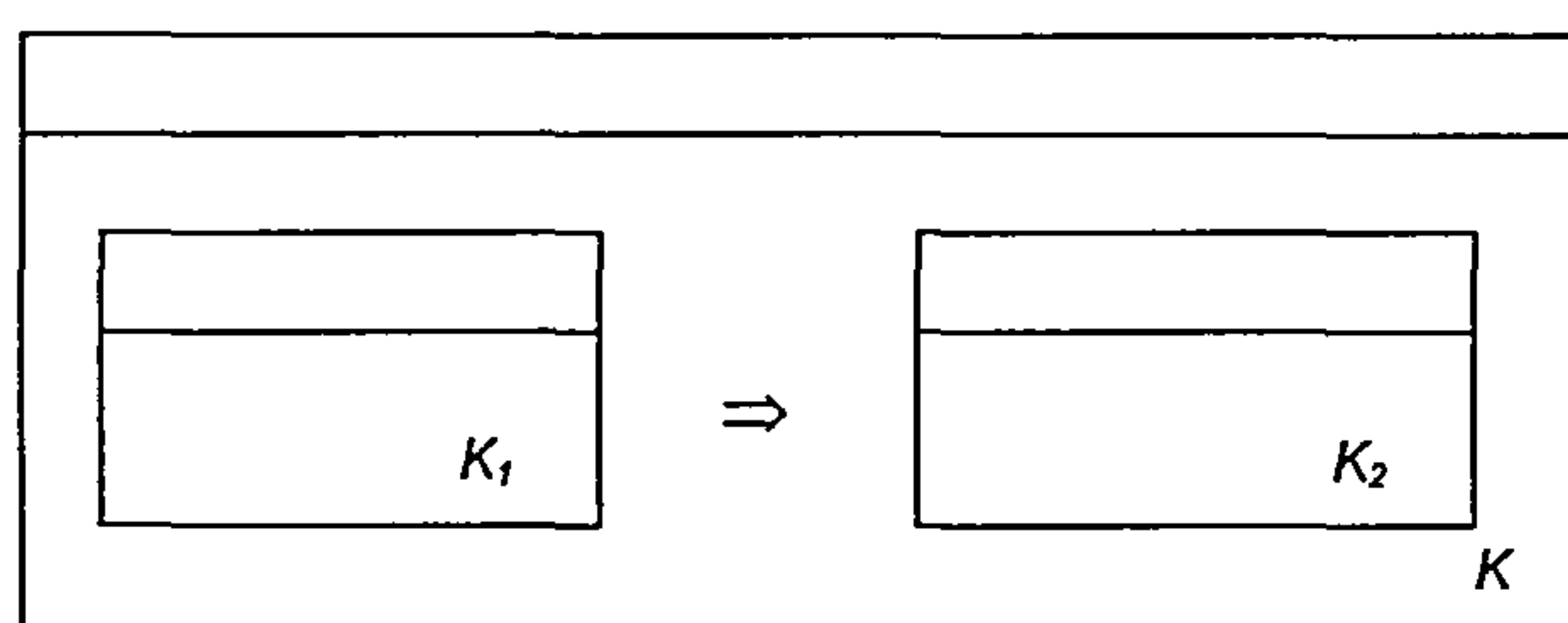
With respect to anaphoric potential, indefinites then seem to behave more like referential expressions like proper names which have unlimited anaphoric

scope. This behaviour is taken to provide evidence for the DRT claim that indefinites do not contribute the traditional existential quantifier in the semantic representation. Instead, an analysis as open formulae containing a ("novel") variable (Heim 1982, the *Novelty Condition*), or as introducing a new discourse referent (Kamp 1981) is necessary to account for these properties. This analysis firstly models the potential of such terms to modify their context of occurrence in terms of subsequent anaphoric possibilities and secondly accounts for their seemingly variable quantificational force: in the presence of a quantificational term in the same scope domain free variables/discourse referents can become bound⁶. This is what explains how the effect of variable quantificational force is brought about. On the other hand, under the assumption that pronominals require identification/coindexing with a variable/discourse referent already present in the discourse representation, the extended binding potential of indefinites is explained because the element they introduce becomes available for such purposes. The existential readings most frequently associated with indefinites are then analysed as arising from a general operation of *existential closure* in the syntax (Heim 1982) or attributed to the interpretation process for DRSs in Kamp (1981), Kamp & Reyle (1993). The latter is as follows: The semantics for natural language presented in Kamp (1981) define truth not for each sentence individually but rather for the whole discourse whose content is represented by a DRS K . K is taken to be a partial model (cf. van Eijk 2005: 6). In order for the discourse to be evaluated as 'true' relative to a DRS K in a model M , K must be embeddable in M by means of an *embedding function*. A function f embeds K in the model M if it assigns individuals to the discourse referents that satisfy all the conditions specified in the K . The truth definition states that if such an f can be found then the discourse is true relative to M . Since the verification of the whole DRS relies on the existence of an embedding function for the discourse referents contributed by indefinites, the effect of existential quantification is achieved indirectly through the truth evaluation of the DRS.

⁶ Kamp's semantics of implicative conditions amount to unselective quantification over free variables in the antecedent, see below.

The referent introduced by an anaphoric NP in DRT must be identified with an “old”, “familiar”, discourse referent but selection of such a referent is not unrestricted. A discourse referent is only available if it appears in a *local* DRS universe. Locality is defined according to the postulated hierarchical structure of the DRS (which, in effect, reflects its semantic interpretation see Chierchia & Rooth 1984). The content of propositions that are asserted as true in a discourse is inserted in the main (*matrix*) DRS. Propositional connectives like negation and implication and quantifiers like *every* establish hierarchical structure in a DRS by introducing subordinate boxes. Negation introduces a subordinate box prefixed by \neg whereas conditional sentences and universal quantification are analysed as causing ‘box-splitting’, that is, introducing two subordinate DRSs in the main DRS related by the connective \Rightarrow (this is partly revised in Kamp & Reyle 1993):

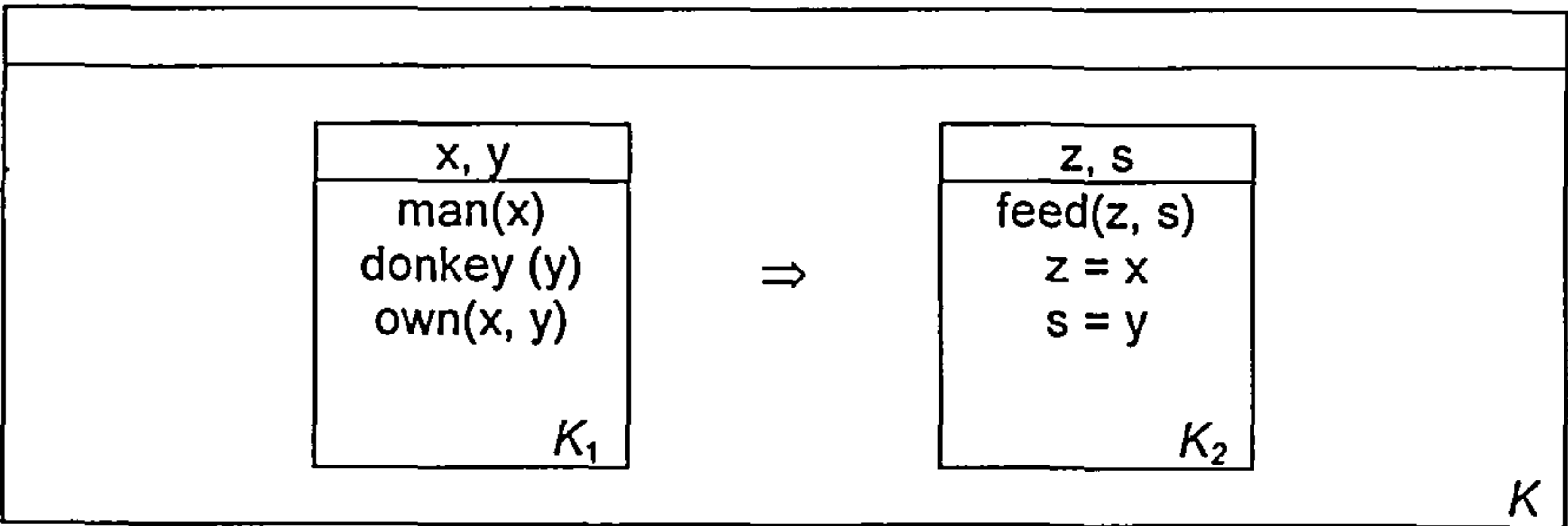
(26)



The possibility of having subordinate DRSs with their own universes requires the definition of *accessibility relations* between sub-DRSs so that already present discourse referents can be reused for anaphoric resolution purposes. The accessibility relations defined for DRSs in effect require that antecedents for discourse referents can only be found in the universes of other DRSs in case those can be reached by moving in the direction *left* and *upwards*. So a discourse referent in K_2 above can be identified with any discourse referent occurring in either K_1 or K (or in K_2 itself of course). However, a discourse referent in K cannot access one in K_1 or K_2 nor can a discourse referent in K_1 access a referent in K_2 . For the representation of donkey sentences such accessibility relations explain the felicitous anaphoric relations that can be established between terms in the protasis and the apodosis of a conditional. Below in (27), the identity symbol between discourse referents, e.g. $z = x$,

indicates that the relevant discourse referents have been identified because an anaphoric relation has been assumed to hold between the respective linguistic terms (*a man*, *he*) that gave rise to them:

(27) If a man owns a donkey he feeds it



The semantics assigned to such structures reconstructs the apparent universal force that indefinites seem to be associated with in these cases. According to the DRS evaluation rules, the *DRS* K above is true with respect to a particular model M just in case there is an embedding function f from the universe of K into M . To check whether f satisfies K we have to check whether f assigns individuals to the discourse markers in the universe of K such that the conditions inside K are satisfied. Here the only condition we need to consider is the embedded *implicative* condition $K_1 \Rightarrow K_2$. Such conditions will be satisfied by f iff for *all* extensions g of f which verify the DRS depicted as the first box there are extensions h which verify the DRS depicted as the second box. Now, since the universe of K contains no discourse referents f will be the empty function. The evaluation rule for \Rightarrow will then consider all extensions of the empty function f which satisfy K_1 . To satisfy K_1 a function g must assign to x and y a pair of man and donkey where the man owns the donkey. All of those embedding functions g must then be able to be extended to functions h such that the man in the pair feeds the donkey in the pair. This makes the implicative condition equivalent to unselective universal quantification over man-donkey pairs since for every pair of man and donkey that participate in the ownership relation we must find that they also participate in the feeding relation. In this respect, since the consequent is interpreted with respect to the functions that verify the antecedent we now

have a notion of *subordination* of the interpretation of the consequent to the antecedent. Under this assumption therefore the antecedent can be seen as providing the *context* for processing the consequent.

However, despite its success with analysing donkey sentences, as we saw in the previous chapter, the DRT account cannot be the whole story as regards anaphora and conditionals. The anaphoric relations in conditionals can certainly go the other way:

(28) *A farmer feeds a donkey if he owns it.*

There is no explanation for these phenomena in DRT unless some syntactic processing taking place before DRS construction is postulated independently. In this respect, we are again obliged to make a distinction between sentence-internal and discourse phenomena which does not provide a unified model of linguistic interpretation. Moreover, despite the claimed uniform analysis of indefinites and pronouns in DRT, quantificational expressions, e.g. universals, are treated completely distinctly from other NPs in that they are assumed to introduce superstructure above the referents they introduce so that they become invisible from the main DRS for anaphoric purposes. And despite the fact there is a claimed uniform analysis of indefinites and pronouns/definites, the Novelty/Familiarity distinction in Heim (1982), shown to be technically problematic in Chierchia (1995), and the requirement for identification with “old” referents in Kamp do not really bear this claim out. Moreover, the ad hoc Existential Closure mechanism introduced by Heim and the semantic interpretation designed to existentially interpret indefinites assumed by Kamp once more characterise these elements as somehow “special”. Nevertheless, the same effects of introducing referents in the representation can be equally achieved by the use of a universal expression, especially as far as plural pronouns are concerned:

(29) *Every British soldier_i aimed and then he_i killed an enemy soldier.*
 (from Carminati et al. 2002)

- (30) Every/Each executive_i went home. He_i broiled a steak. He_i ate dinner. Then he_i watched television.
 (from Carminati et al. 2002)
- (31) Every British soldier_i is on leave. They_i went to town.

The phenomena seen in (29)-(30), termed *non-c-command binding* and *telescoping*, cannot be handled in classical DRT without further ado (see e.g. the *Accommodation* approach of Roberts 1989, and also Kadmon 1987, Poesio & Zucchi 1992). However, experiments reported in Carminati et al. (2002) show that subjects' reactions to such sentences do not justify any special mechanisms postulated in order to accommodate them. Moreover, it is not clear that plural anaphora should receive such a distinct treatment from singular anaphora as the one proposed in Kamp & Reyle 1993 to account for the successful anaphoric relation in (31) (see Wang et al. 2005).

1.b. Dynamic Semantics

DRT has also been criticized as "non-compositional" by Groenendijk and Stokhof (1990,1991). The doctrine of strict compositionality (involving a Montagovian *homomorphism* between syntax and semantics) is not relevant for present considerations since the DS approach that we employ here is unashamedly representational and partly top-down. DS is compatible with traditional truth conditional semantics (for LOT representations) because the dynamics deemed necessary for interpretation in other frameworks is incorporated inside the grammar formalism that constructs the representations for sentences while interacting with pragmatically motivated processes (cf. Geurts 1999, Dekker 2002). The Dynamic Semantics view of *linguistic* meaning is as a function from existing information states (or contexts) into new information states. Such functions are called "information updates" or *context change potentials*. In Heim's (1982: ch. 3) version of dynamic semantics, construal rules at LF are abandoned and LF-formulas get recursively associated with context change-potentials by the semantics. The dynamic system, of Groenendijk and Stokhof (*DPL*, 1990, 1991), further elaborated in Chierchia (1992, 1995), differs from DRT in that it takes a

'context' to be a *semantic*, as opposed to a *syntactic/representational*, object. This object is conceptualised as an information state consisting of a set of assignments (or pairs of a possible world and a variable assignment $\langle w, g \rangle$), namely those assignments that assign entities to the variables appearing in a formula such that the formula is verified in the model. A *static* semantics, like that assigned to DRT formulas can be thought of as being given by the set of assignments that satisfy a formula. In DPL on the other hand, every formula receives as its interpretation a set of ordered pairs of possible input-output assignments. For our purposes what is important in this type of semantics is the analysis of indefinites: Promoted as one of its main advantages, DPL goes back to the original Russellian conception of indefinites as existential quantifiers. However, the need for indefinites to allow binding beyond their syntactic scope is now achieved by assigning special properties, reflecting context manipulation, to the existential quantifier and conjunction. In cases involving the existential quantifier, the information state changes by modifying the input assignment so that it assigns an object as the value of the bound variable that satisfies the scope of the quantifier (φ below). The general rule of evaluation for $\exists x\varphi$ is given below:

$$(32) \quad \llbracket \exists x\varphi \rrbracket = \{ \langle g, h \rangle \mid \text{there is some } k: k[x]g \wedge \langle k, h \rangle \in \llbracket \varphi \rrbracket \}$$

By this rule, a pair of an input assignment g and an output h belongs to the interpretation of $\exists x\varphi$ just in case there is a k which differs from g at most at what it assigns to x ($k[x]g$) and $\langle k, h \rangle$ is a possible input/output pair for φ . The rule for evaluating atomic predicate-argument formulas with respect to a model $M = (D, F)$, D a domain of entities and F an interpretation function, is as follows:

$$(33) \quad \llbracket R(t_1 \dots t_n) \rrbracket = \{ \langle g, h \rangle \mid h = g \wedge \langle \llbracket t_1 \rrbracket_h \dots \llbracket t_n \rrbracket_h \rangle \in F(R) \}$$

Processing of such formulas does not change the context ($h = g$). Instead a *test* is performed on the incoming assignments to see whether they satisfy the predication. Sentence sequencing is modelled in DPL as conjunction of formulas. To explain how cases of E-type anaphora are handled we need a

rule for conjunction that passes on values of variables from one conjunct to the other:

$$(34) \quad \llbracket \varphi \wedge \psi \rrbracket = \{ \langle g, h \rangle \mid \text{there is some } k: \langle g, k \rangle \in \llbracket \varphi \rrbracket \ \& \ \langle k, h \rangle \in \llbracket \psi \rrbracket \}$$

This rule characterises \wedge , similarly to \exists , as both *internally* (between conjuncts) and *externally* (beyond the conjunction) dynamic. This is because the assignments that are passed on from the left to the right conjunct are those that from the initial assignment g give as output an assignment k satisfying φ and k in turn can be updated to h in terms of ψ . This process can be repeated indefinitely thus extending the scope of an initial existential quantifier far beyond its syntactic scope. This rule in combination with the rule for existential quantification permit the dynamic treatment of discourses like:

$$(35) \quad \text{There is a man}_i. \text{ He}_i \text{ walks.}$$

Pronouns are modelled as free variables and the discourse is treated as a conjunction:

$$(36) \quad \exists x[\text{Man}(x)] \wedge \text{Walks}(x)$$

The pair $\langle g, h \rangle$ is in the interpretation of the conjunctive formula just in case g applied to $\exists x[\text{Man}(x)]$ produces an output k which in turn produces an output h for $\text{Walks}(x)$. Evidently, k must satisfy both $\text{Man}(x)$ and $\text{Walks}(x)$. It thereby follows that the conjunction above is equivalent to:

$$(37) \quad \exists x[\text{Man}(x) \wedge \text{Walks}(x)]$$

which is the desired result and, according to Chierchia (1995), the main law of Dynamic Semantics. Conditionals in Dynamic Semantics are treated as internally dynamic but externally static in that they pass on assignments for the antecedent to the consequent but not beyond. A conditional formula is interpreted as follows:

$$(38) \quad \llbracket \varphi \rightarrow \psi \rrbracket = \{ \langle g, h \rangle \mid h = g \ \& \ \text{for all } k: \langle h, k \rangle \in \llbracket \varphi \rrbracket \text{ there is some } j: \langle k, j \rangle \in \llbracket \psi \rrbracket \}$$

The output assignments in the interpretation of a conditional do not differ from the initial inputs. Therefore conditionals are also *tests*: only those assignments are retained which having an update k that satisfies the antecedent of the conditional they can be updated to a j such that the consequent is satisfied. In effect, this results in an indirect assignment of universal force to an existentially quantified term in the antecedent since we require that all assignments k must have at least one update j that satisfies the consequent. Groenendijk & Stokhof (1990) also suggest that an externally dynamic version of the interpretation of the conditional could be defined to deal with the *telescoping* cases like the one seen in (29)-(30) above.

As we have already said the assumption that such a radical change of what meaning consists in is not necessary under DS assumptions as here truth-conditional content is only assigned to LOT representations. The hope is that we can maintain a more conservative view of truth conditions⁷ by assigning the dynamic effects captured by Dynamic Semantics frameworks in terms of the dynamics of the construction of LOT representations reflecting constructively the introduction of content. In a framework that models performance, like DS, such content, stored in the model of the context, can be reused to resolve anaphora. In what regards the latter, Dynamic Semantics is more abstract in that it does not model context change in a direct constructive way but rather by the 'idealised' psychologically unrealistic view of sets of (total) assignments. Therefore, unlike DRT, Dynamic Semantics is not directly embeddable in a procedural performance model. The consequences of such choices can be seen in Chierchia's (1995) analysis of conditionals. As we saw in the previous chapter in order to maintain a direct compositional mapping between natural language and truth conditions not only Dynamic Semantics but also multiple transformationally related syntactic representations have to be assumed. Moreover, pronominal anaphora is taken to require both his version of dynamic semantics (*Dynamic Binding with Existential Disclosure*)

⁷ The interpretation of the epsilon calculus does not constitute a radical departure from the traditional semantics of predicate logic (see Meyer-Viol 1995).

and an E-type strategy postulating in effect that such pronouns are *numberless* (for arguments against this view see Kanazawa 2001). Dynamic Binding reconstructs a (syntactic) notion of scope while the E-type account takes care of pragmatically driven interpretations. From a theoretical point of view the question that arises at this point is whether this dichotomy in Chierchia's analysis can be eliminated in favour of a more integrated account of pronoun reference resolution.

1.c. Situation Semantics and E-type Analyses

In the present approach the way to capture the apparent universal force associated with conditionals has been by analysing them as involving the introduction of epsilon calculus terms whose interpretation ultimately results in universal quantification over situations. In adopting a situation semantics we follow Berman (1987) and von Stechow (1994) who employ Kratzer (1986)'s implementation where a *possible situation* can be seen as a basic entity of the model structure. A possible situation is conceptualised as a part of a world. Thus, besides individuals, models come with a set S of possible situations. There is a partial ordering, \leq , in the set S relating members of S to each other in such a way that there is for any situation $s \in S$ a unique maximal situation (a *world*) of which s is a part, i.e. each situation belongs to one unique possible world. Instead of the *unselective quantification* view of classical DRT, in the situation analysis, all cases of indefinites exhibiting multiple quantificational forces can be attributed to quantification over situations. This is also the view taken here although instead of employing free variables for the analysis of indefinites and existential closure (or disclosure) we attribute uniform name-like content to all quantificational NPs by adopting the epsilon calculus in the LOT representation language. In combination with the analysis of pronouns as metavariables, able to pick up terms introduced by quantificational NPs, we are able to provide a solution to the analysis of sentences like the following which are problematic for other frameworks:

- (39) If a man is in Athens then he's not in Rhodes (*from Heim 1982*)

By adopting τ -terms over situations in combination with the potential of having epsilon terms scopally interacting with them we explain how it is possible that the indefinite in the above is perceived to acquire universal force. On the other hand, because the pronoun *he* in the consequent is able to directly pick up the term introduced by the indefinite we do not need any processes of definite description-like content reconstruction for the pronoun, the latter involving as it does the problematic uniqueness presupposition (the E-type analysis, criticised for this reason in Heim 1982, cf. Heim 1990). Similarly *sage plant* sentences can be analysed without problems as there are no uniqueness requirements⁸:

- (40) If a man buys a sage plant here he always buys three others along with it.

Moreover the constructive view of context employed by DS does not face the often noted problem associated with context dependent *E-type* approaches (e.g. Cooper 1979) which cannot readily provide an answer for the unavailability anaphoric reference in the following:

- (41) John is a cat_i-owner. #It_i is grey.

Although we do not want to exclude the above as ungrammatical in all cases, the modelling of context presented in Cann et al. (2005, Ch. 9) explains the infelicity of the anaphoric reference indicated in particular contexts since it presupposes that the inferential construction of a term representing a cat has to be appealed to, otherwise the string will be ungrammatical.

⁸ With regard to the individuation of situations we adopt Berman's (1987) *vagueness hypothesis* but here in what concerns the individuation of events/situations at the level of LOT (and not natural language) semantics. Since DS is supplemented by a pragmatic account like Relevance Theory such temporary underspecification can be resolved by context-driven inferential processes. Moreover, because we do not adopt any *E-type* definite description-like interpretations for pronouns and definites we do not need to make any problematic assumptions regarding the definition of *minimality* for situations. The situations quantified over are simply those that are considered *relevant* (in the technical sense of Relevance Theory) in a particular context.

We now turn to look in more detail into how the DS approach resolves the problems associated with other frameworks pointed out above.

2. The DS Approach to Quantification

2.a. The problems with DRT and related frameworks

We saw earlier that the DRT and *E*-type approaches to anaphora face the following problems:

- a. Indefinites and other quantificational noun phrases are treated distinctly in that quantificational expressions are assumed to create subordinate structures which serve as accessibility barriers whereas indefinites are treated as variables.
- b. Cataphoric phenomena in conditionals and other structures are problematic or at least they involve utilising a completely separate level of syntactic (sentence-internal) analysis. The same goes for conditionals with anaphoric links in postverbal protases (these issues were dealt with in Chapter 7).
- c. The Novelty/Familiarity Condition which belies the unified treatment of definites and indefinites.
- d. The *E*-type approach does not provide an explanation of how terms are introduced.
- e. The phenomena of quantificational and modal subordination seem to defy the proposed analyses with the result that ad hoc, unrestricted processes of *Accommodation* have to be invoked.

We will now attempt to present the solution to these problems that DS has to offer. We will restrict our attention mostly in the domain of conditional structures and we will provide certain modifications to the formalism to deal with some specific issues having to do with the interface of sentence processing and context construction. We have assumed that conditionals are analysed by means of τ -terms involving situations interacting scopally with other terms. For the most part, below we will omit the added complication of adding the explicit situation argument on the tree when its inclusion does not

make any difference to the argumentation presented. However towards the end of the chapter we will see that the assumption of having this argument represented explicitly as a term provides a solution to some novel “quantificational subordination” data involving the interaction between universal NPs and the scope of the conditional.

2.b. Quantificational terms as names

As we saw in Chapter 3, DS analyses the contribution of quantificational expressions uniformly as deriving terms in the epsilon calculus. Upon initial introduction these terms are incomplete in that they consist solely of the quantificational binder, the variable and the Restrictor contributed by the common noun processed, e.g.: a phrase like *a man* will give us: $\epsilon, x, \text{Man}'x$ ⁹. These incomplete terms provide the input to the *Q-Evaluation Rule* which allow the Nuclear Scope, the predication on the term, to be incorporated inside the term itself. For illustration, consider sentence (16) below:

(42) A man saw every woman

At the first stage of the parsing of this string the following formula will be constructed at the top node of the tree:

(43) $\text{Fo}(\text{Saw}' \tau, y, \text{Woman}'y \ \epsilon, x, \text{Man}'x)$ ¹⁰

This formula is still semantically incomplete in that there is no way of knowing whether it is a specific man who every woman saw or whether for each woman there is a (potentially different) man who saw her. In order for the ambiguity to be resolved the formula in (43) will always be accompanied by a *Scope Statement* (indicated by the predicate *Scope*) which will unambiguously indicate which term depends on which other. In a scope statement a term is represented by the variable it binds which is guaranteed

⁹ For readability purposes we will sometimes omit the commas between the components of such terms. Additionally we will drop parentheses and brackets when there is no risk of misunderstanding.

¹⁰ For readability purposes dotted underlining will be employed to avoid excessive use of parentheses.

by the parsing rules to be fresh and unique (e.g. the term $\epsilon, x, \text{Man}'x$ above will be represented by x). The variables in such a statement are ordered according to their dependencies:

(44) Scope($x < y$)

The symbol $<$ between the two variables x and y indicates that the term employing the variable on the left ($\epsilon, x, \text{Man}'x$) outscopes the term employing the variable on the right ($\epsilon, y, \text{Woman}'y$). If such a scope statement accompanies the formula in (43) above then the interpretation that the whole represents would be expressed in predicate logic as follows:

(45) $\exists x [\text{Man}'x \wedge \forall y (\text{Woman}'y \rightarrow \text{Saw}'yx)]$

On the other hand if the dependency is presented the other way round, i.e.,

(46) Scope($y < x$)

then the equivalent interpretation in predicate logic will be:

(47) $\forall y [\text{Woman}'y \rightarrow \exists x (\text{Man}'x \wedge \text{Saw}'yx)]$

The formula in (43) and the Scope Statement accompanying it will be utilized at the end of the parse as input to the rule of Q-Evaluation which will construct the appropriate complex terms that record inside their restrictors the scope dependencies selected to hold:

(48) Fo(Saw' $\tau, y, \text{Woman}'y$ $\epsilon, x, \text{Man}'x$), Scope($x < y$)

$\xrightarrow{\text{Q-EVALUATION RULE}}$

Man'a \wedge (Woman'b_a \rightarrow Saw'b_a a)
 where a = $\epsilon, x, \text{Man}'x \wedge \text{Woman}'b_x \rightarrow \text{Saw}'b_x x$
 where b_x = $\tau, y, \text{Woman}'y \rightarrow \text{Saw}'yx$
 where b_a = $\tau, y, \text{Woman}'y \rightarrow \text{Saw}'ya$

(49) Fo(Saw' $\tau, y, \text{Woman}'y$ $\epsilon, x, \text{Man}'x$), Scope($y < x$)

$\xrightarrow{\text{Q-EVALUATION RULE}}$

Woman'b \rightarrow (Man'a_b \wedge Saw' b a_b)
 where b = $\tau, y, \text{Woman}'y \rightarrow (\text{Man}'a_y \wedge \text{Saw}'ya_y)$

where $a_y = \varepsilon, x, \text{Man}'x \wedge \text{Saw}'yx$
 where $a_b = \varepsilon, x, \text{Man}'x \wedge \text{Saw}'b a_b$

We will now see how these rules interact with anaphoric processes so that notions of variable binding, *E*-type interpretations and deictic anaphora are unified under a single account.

2.c. The interaction between quantification and anaphora: a DS view

As we saw, anaphoric elements like pronouns are analysed in DS as always providing metavariables (**U**, **V**, **W** etc.) which must be substituted from among the terms already present in the representation. In the cases characterised in other frameworks as *bound anaphora*, where a pronoun occurs inside the scope of a quantificational term, instead of analysing the pronoun as a free variable/discourse referent, DS assumes that the incomplete term provides an available replacement:

- (50) Every man thinks he is right
 (51) Think' ($\text{Right}'_{\tau, x, \text{Man}'x}$) ($\tau, x, \text{Man}'x$)

The application of the *Q-Evaluation Rule* then derives a representation of the appropriate truth conditions in which the pronoun occurs in effect as a variable bound inside the term. Consider the rule for quantifier evaluation which applies at the end of the parse:

(52) **Q-Evaluation Rule:**

$$\frac{\{ \dots \{ \text{Ty}(t), \dots, \text{World}(w[x_1]), \text{Scope}(x_1 < \dots < x_n), \text{Fo}(\varphi[v x_n \psi_n/x_n]) \dots \} \}}{\{ \dots \{ \text{Ty}(t), \dots, \text{World}(w[x_1]), \text{Scope}(x_1 < \dots < x_{n-1}), \dots, \text{Fo}(f_{v_n x_n \psi[v x_n \psi_n/x_n]}(\varphi)), \dots \} \}}$$

where for x occurring free in φ and $w[x_1] =$ a world variable x_1 or $w[x_1] = v_1 x_1 \psi$, the values $f_{v_n x_n \psi[v x_n \psi_n/x_n]}(\varphi)$, for $v \in \{\varepsilon, \tau, Q\}$ and $f_{w[x_1]}(\varphi)$ are defined by:

- (a) $f_{\tau x \psi}(\varphi) = \psi[a/x] \rightarrow \varphi[a/x]$
 where $a = \tau x (\psi \rightarrow \varphi)$
 (b) $f_{\varepsilon x \psi}(\varphi) = \psi[b/x] \wedge \varphi[b/x]$
 where $b = \varepsilon x (\psi \wedge \varphi)$
 (c) $f_{Q x \psi}(\varphi) = (\psi[c/x]) (\varphi[c/x])$
 where $c = v_Q x ((\psi)(\varphi))$

$$(d) \quad f_{w[x_1]}(\varphi) = w[x_1]: \varphi$$

Application of this rule has the effect initially of removing the incomplete term, wherever it occurs, and replacing it with its variable. When the term is reintroduced in the formula in its complete form the variable has become bound inside the term:

$$\begin{array}{ll} (53) & \text{Think' (Right'x)(x)} \Rightarrow \\ (54) & \text{Man'a} \rightarrow \text{Think' (Right'a)(a)} \quad \text{where } a = \tau, x, \text{Man'x} \rightarrow \text{Think' (Right'x)(x)} \end{array}$$

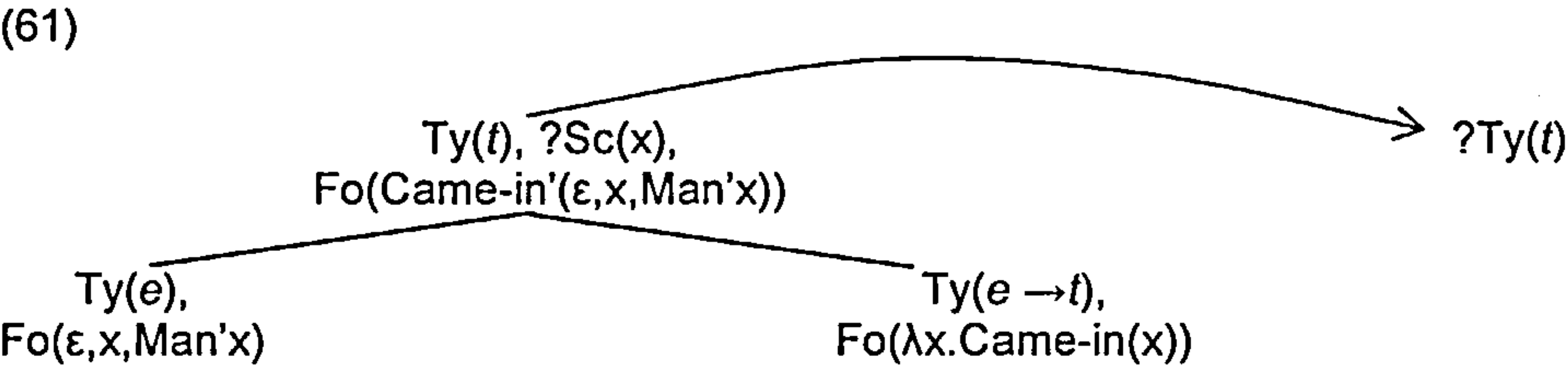
This gives us the effect achieved in other frameworks by translating a pronoun as a variable which is then bound by the quantifier (but notice that the pronoun never behaves as anything else but a regular anaphoric element inducing the operation of Substitution).

For the cases of cross-sentential anaphora involving quantificational expressions the same procedure is followed: it is assumed that the epsilon term constructed by the processing of a previous sentence remains available in the *Discourse Context* for the replacement of the metavariable contributed by a pronoun subsequently:

$$\begin{array}{ll} (55) & \text{A man came in.} \Rightarrow \\ (56) & \text{Ty}(t), \text{Fo}(\text{Man'a} \wedge \text{Came-in'a}) \quad \text{where } a = \varepsilon, x, \text{Man'x} \wedge \text{Came-in'x}) \\ (57) & \text{He sat down.} \Rightarrow \\ (58) & \text{Ty}(t), \text{Fo}(\text{Sat-down' (U)} \xrightarrow{\text{Substitution}} \\ (59) & \text{Ty}(t), \text{Fo}(\text{Sat-down'(a)} \text{ where } a = \varepsilon, x, \text{Man'x} \wedge \text{Came-in'x}) \end{array}$$

There is another way of processing sequences like the above: the possibility of building LINKed trees also allows them to be processed in tandem, i.e. we can initiate the interpretation of the second sequence before we have completely finalised the first one: after the construction of a type *t* tree structure has been completed and before the *Q-Evaluation Rule* applies we can invoke a general LINK rule, not induced by lexical input, to create a transition to a new tree:

(60) **LINK Introduction Rule:**
 IF $Ty(X)$
 THEN $make(<L>); go(<L>); put(?Ty(X))$
 ELSE $abort$

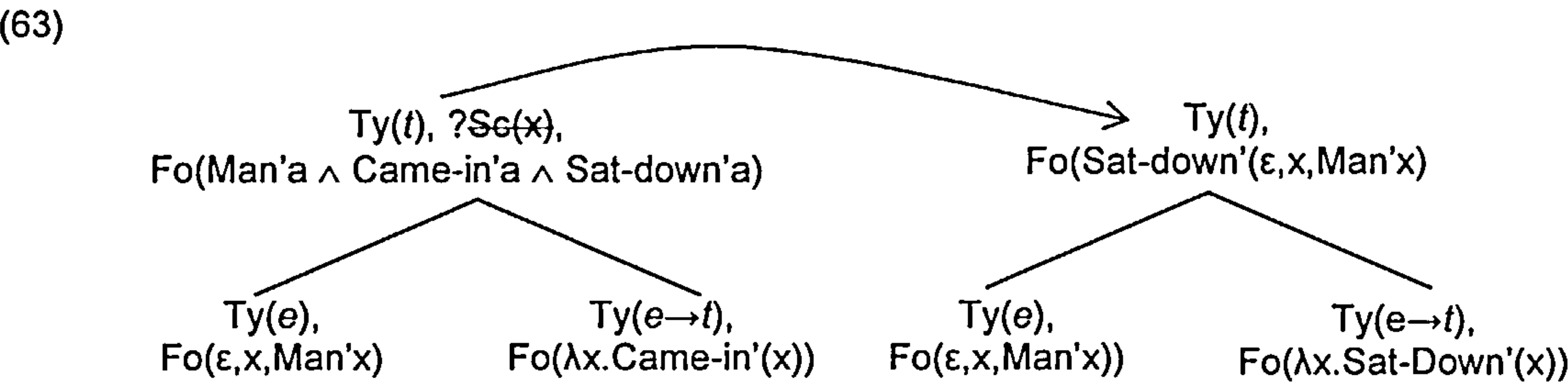


Now processing of the pronoun *he* in the string *he sat down* will ensue in a metavariable decorating the subject node of the new tree. The *incomplete* epsilon term $\epsilon, x, Man'x$ can be used to replace this metavariable. After the processing of the LINKed tree has finished, the *LINK Evaluation Rule* can apply to allow return of the pointer to the main tree and the incorporation of the formula derived from the LINKed tree into the formula decorating the main tree:

(62) **LINK Evaluation Rule:**

$$\frac{\{... \{Tn(X), Ty(t), Fo(\varphi) \}, \{<L^1>Tn(X), Ty(t), Fo(\psi), \diamond \}, ...\}}{\{... \{Tn(X), Ty(t), Fo(\varphi \wedge \psi), \diamond \}, \{<L^1>Tn(X), Ty(t), Fo(\psi) \}, ...\}}$$

The *Q-Evaluation Rule* will now apply to the whole newly introduced formula $(\varphi \wedge \psi)$ thus extending the scope of the epsilon term across the two sentences:



As evidence that we need this additional method of processing juxtaposed sentences consider cases like the following where the content of the second sentence must be “subordinated” to the propositional attitude or dream report (cf. Farkas 1997):

(64) John thought that a man came in. He sat down. He started talking.

This explains regular types of anaphoric linkage. The availability of discourse referents introduced in the antecedent of a conditional to referents in the consequent is achieved by the special stipulation of allowing accessibility from the consequent to the antecedent (leftwards) but not in the opposite direction. Since universal quantifier expressions are interpreted as introducing the same type of implicative substructure inside a DRS as a conditional, the same accessibility restrictions will apply. This explains the claimed contrast between (70)-(71) and the following:

- (72) # If every man_i owns a donkey_k he_i feeds it_k
 (73) # A man who owns every donkey_k feeds it_k

We will see that at least for the cases involving conditionals there is reason to dispute these judgements. Firstly though we have to see how to handle donkey sentences involving relatives in DS.

2.c.1.a. *Donkey sentences with relatives*

In DS the problem posed by the processing of donkey pronouns with antecedents inside a relative clause (*Every man who had a donkey fed it*) can be dealt with by the usual assumptions relating the processing of a main and a LINKed tree. Kempson (2003) discusses the following case:

- (74) Every child [who a *friend of mine* had upset] cried

The processing of this string involves a relative clause modifying the universal quantifier. The relative clause contains the indefinite *a friend of mine*. The potential scope dependencies concerning this indefinite cause ambiguity: It can depend on the universal quantifier in which case the following formula reflects the truth conditions of the sentence¹¹:

- (75) $\forall x [(\text{Child}'x \wedge \exists y(\text{Friend}'y \wedge \text{Upset}'xy)) \rightarrow \text{Cried}'x]$

Alternatively, the indefinite can be interpreted with scope wider than the universal:

¹¹ For simplicity of illustration we omit reference to the indices of evaluation where their inclusion would not make a difference to the argumentation.

(76) $\exists y [\text{Friend}'y \wedge (\forall x (\text{Child}'x \wedge \text{Upset}'xy) \rightarrow \text{Cried}'x)]$

The DS derivation of both interpretations is achieved from identical tree representations by manipulating the order of elements in the Scope Statement (therefore resolution of scope in DS is non-configurational). Both readings can result from the building of a main and a LINKed tree and copying of Formula values from one to the other. For the interpretation in (76), with the term representing the epsilon term derived from the indefinite having widest scope, we can assume that this term depends only on the index of evaluation (world or situation) in the main tree so that the term representing the universal has scope narrower than it. On the other hand, if the interpretation in (75) with the universal having wide scope is selected, in DS, there are two ways for it to be achieved: either (a) the variable assigned to the ϵ -term depends on the situation/world of evaluation introduced on the tree representing the content of the relative, or, (b) the ϵ -term depends on the variable introduced by the τ -term (we will show the world of evaluation as a label w_1, w_2, \dots, w_n here, and as an argument of the monadic *World* predicate, see Chapter 4, 4.b.1)¹². In order to ensure this we must now redefine the predicate *DOM* seen earlier in Chapter 4, which takes care of constraining the choices available for the replacement of the metavariable introduced in the scope statement constructed for an indefinite. Remember that the *Scope Action for Indefinites* rule introduces a metavariable as the first member of the scope statement regarding the variable introduced by an indefinite as well as a requirement that this metavariable must find a replacement which satisfies the predicate *DOM*:

¹² We will also omit reference to the situation argument for simplicity; however it must be kept in mind that there is the possibility for wide or narrow scope for the term contributed by the indefinite with respect to the situation arguments too; following the analysis presented in the previous chapters this can be handled in exactly the same way as with any other arguments so for readability purposes we omit its inclusion in the representations.

(77) **Scope Action for Indefinites:**

IF { Indef(+), ?Sc(**x**) }
THEN gofirst_t(?Ty(*t*));
 put(Scope(**U**<**x
 ? $\exists y.(DOM(y) \wedge Scope(y < x) \wedge \forall r(Scope(y < r) \rightarrow Scope(x < r))$))
ELSE abort**

We can now define the predicate *DOM* as follows:

$$\begin{aligned}
 (78) \quad T_n \models_M DOM(a)^{13} \Leftrightarrow \\
 T_n \models_M ?Ty(t) \wedge \\
 [(\downarrow \downarrow [Ty(e) \wedge \langle \downarrow_0 \rangle \langle \downarrow_0 \rangle Fo(a)]) \vee \langle \downarrow_0 \rangle Fo(v_{[a]}) \vee World(v_{[a]}) \\
 \vee \langle U \rangle World(v_{[a]})] \\
 \text{where } v_{[a]} = (q, a, \phi a \text{ where } q = \varepsilon/\tau/Q^{14}) \vee (v_{[a]} = a)
 \end{aligned}$$

This definition will allow the variable introduced by processing the indefinite to establish a dependency on one of three kinds of variables: (a) on a variable which is included in an argument subtree of the local tree, or, (b) a variable which is itself an argument in the local tree, or, (c) a world variable, indicated as the argument of the predicate *World*, which can be the local world variable or some higher one. Having established this modification we can now resume illustration of the two ways an indefinite inside the relative that modifies a universal expression can appear to have narrow scope with respect to it.

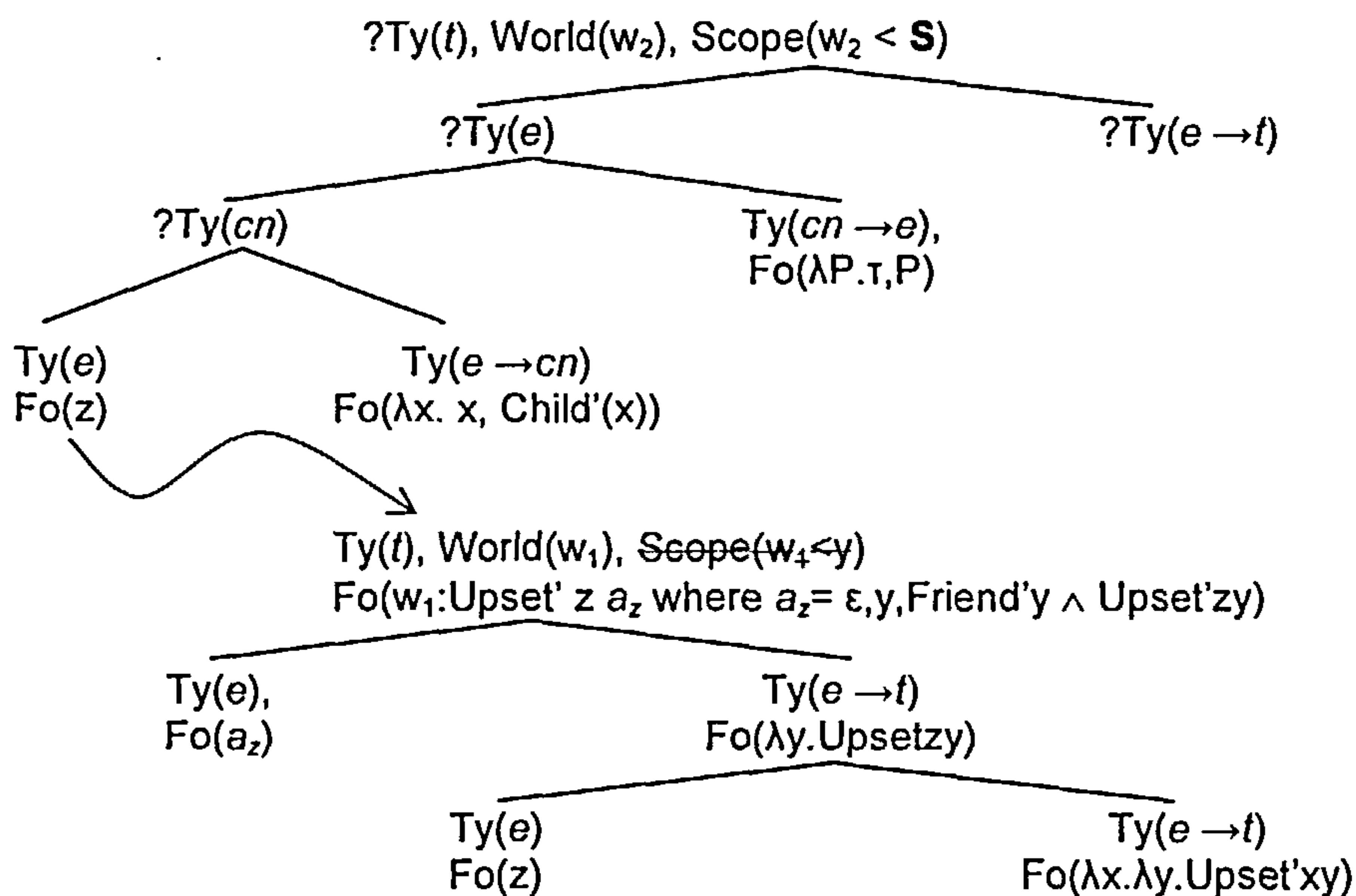
In case the ε -term has narrow scope with respect to the world or situation of evaluation inside the LINKed tree, the completion of this term can be finalised before processing of the main clause resumes. This is because the other term on which it depends is part of the same LINKed tree to which it belongs. Below it is shown how after the LINKed tree has been completed the epsilon term (simplified to: $\varepsilon, y, \text{Friend}'y$) derived from processing the indefinite

¹³ In Kempson et al (2001) where the situation argument is treated as a label there is a slightly different definition of the predicate DOM.

¹⁴ Q stands for any other quantificational binder like those contributed by expressions like *most*, *few* etc. (see Kempson et al. 2001)

a friend of mine has been evaluated with respect to the LINKed tree to become: $\varepsilon, y, \text{Friend}'y \wedge \text{Upset}'yz$, abbreviated on the tree representation as a_z (indicating that it contains the free variable z , the variable that will be bound by the τ -binder):

(79) Every child who a friend of mine had upset \Rightarrow



When processing of the whole string has been finalised the resulting formula will be:

(80) $\text{Cry}'(\tau, z, \text{Child}'z \wedge w_1: (\text{Upset}'za_z)), \quad \text{Scope}(w_2 < z)$
 where $a_z = \varepsilon, y, \text{Friend}'y \wedge \text{Upset}'zy$.

Evaluation of the latter will produce the following¹⁵:

(81) $w_2: (\text{Child}'b \wedge w_1: \text{Upset}'ba_b \rightarrow \text{Cry}'b)$
 where $b = (\tau, z, \text{Child}'z \wedge w_1: \text{Upset}'za_z \rightarrow \text{Cry}'z)$
 where $a_b = (\varepsilon, y, \text{Friend}'y \wedge w_1: \text{Upset}'by)$.

This formula is equivalent to (75) (ignoring the contributions of indices of evaluation).

¹⁵ Incidentally, we see here the benefit of assuming that a situation term is a proper argument rather than a label: since according to the current rules the label is attached externally to the formula, the term when copied to a completely independent tree will not bear an indication of its index of evaluation.

The second way of assigning narrow scope to the (interpretation of the) indefinite with respect to the universal is to assume that the variable y representing the ε -term inside the LINKed tree is explicitly declared to depend on the variable z representing the τ -term. In these cases the *Q-Evaluation Rule* cannot apply for this term while it is located inside the LINKed tree because the other term on which it depends does not occur there¹⁶. For this reason the scope statement will have to be *lifted* from the LINKed tree to the root node of the main tree. Since there is an established dependency between the lifted variable and the terms in the main tree the *Q-Evaluation Rule* (modified as shown below) can apply taking into account this variable too. The rule achieving this lifting is as follows:

(82) **Scope statement Lifting Rule:**

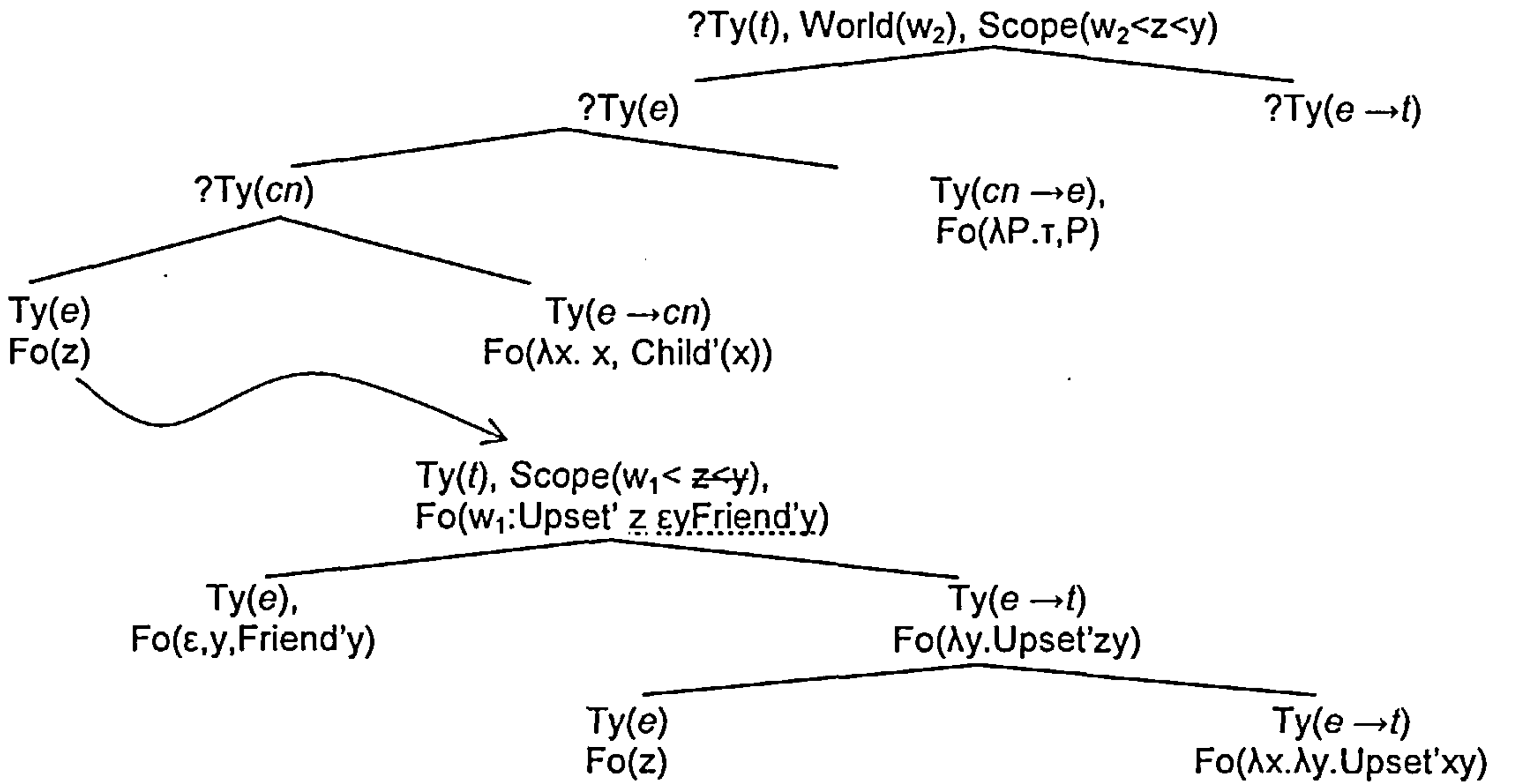
$$\frac{\begin{array}{c} \{ \{ T_n(X), ?Ty(t), \dots \}, \\ \dots \{ \text{MOD}(T_n(X)), Ty(t), \dots, \text{Scope}(\dots z_i < x_i \dots), \dots, \diamond \} \} \} \end{array}}{\begin{array}{c} \{ \{ T_n(X), ?Ty(t), \dots, \text{Scope}(\dots z_i < x_i \dots), \dots \}, \\ \dots \{ \text{MOD}(T_n(X)), Ty(t), \dots, \diamond \} \} \} \end{array}} \\ \text{MOD} \in \{ <\uparrow_0>, <\uparrow_1>, <L^1> \}^*$$

For reasons that are explained in the previous footnote and below, we will assume here that such lifting is optional and that it can equally apply to both tau and epsilon terms. The tree representing the state of the tree representation after the relative has been processed and under the assumption that the indefinite is interpreted as dependent on the universal with a lifted Scope Statement is as follows:

¹⁶ Kempson (2003) seems to reserve this analysis for cases where the indefinite takes widest scope, i.e. where it also takes wide scope with respect to the τ -term, because it depends on the higher index of evaluation. However since the scope statement for the indefinite appears as including a metavariable (e.g. $U<y>$) and this metavariable can be replaced by the variable representing the index of the main clause structure (e.g. $\text{Scope}(S_2<y>$) there is no *technical* reason why the evaluation of the epsilon term should be prohibited from occurring in the relative clause structure. The alternative proposed here of free lifting can be extended to cover all cases where the indefinite (or other types of term as we will see below) depends on another term. This could provide a solution to the following:

- (i) The woman who *every man* respects is *his* mother.
- (ii) The man who builds *each television set* also repairs *it*
- (iii) Somebody in *every city* despises *it*
- (iv) *Every boy's* mother likes *him*
- (v) The uniform that *every nurse_i* had thrown away that night was now lying on *her_i* bed

(83) Every child who a friend of mine had upset \Rightarrow



The resulting formula after all the lexical input has been processed will be:

(84) $Cry'(\tau, z, (Child'z \wedge w_1: Upset'(z)(\epsilon y Friend'y)) \wedge Scope(w_2 < z < y)).$

We now need to introduce a minor modification to the *Q-Evaluation Rule* in order to be able to process such structures. The amendment consists in substituting the τ -term inside the restrictor (ψ) too with its bound variable so that it can include the newly constructed name after evaluation.

(85) **Q-Evaluation Rule:**

$$\frac{\{ \dots \{ Ty(t), \dots, World(w[x_1]), \dots, Scope(x_1 < \dots < x_n), Fo(\varphi[v x_n \psi_{[v x_n \psi_n/x_n]_n}/x_n]), \dots \} \}}{\{ \dots \{ Ty(t), \dots, World(w[x_1]), Scope(x_1 < \dots < x_{n-1}), \dots, Fo(f_{v_n x_n \psi_{[v x_n \psi_n/x_n]_n}}(\varphi)), \dots \} \}}$$

where for x occurring free in φ and $w[x_1] =$ a world variable x_1 or $w[x_1] = v_1 x_1 \psi$, the values $f_{v_n x_n \psi_{[v x_n \psi_n/x_n]_n}}(\varphi)$, for $v \in \{\epsilon, \tau, Q\}$ and $f_{w[x_1]}(\varphi)$ are defined by:

- (a) $f_{\tau x \psi_{[v x_n \psi_n/x_n]_n}}(\varphi) = \psi[a/x] \rightarrow \varphi[a/x]$
 where $a = \tau x (\psi \rightarrow \varphi)$
- (b) $f_{\epsilon x \psi_{[v x_n \psi_n/x_n]_n}}(\varphi) = \psi[b/x] \wedge \varphi[b/x]$
 where $b = \epsilon x (\psi \wedge \varphi)$

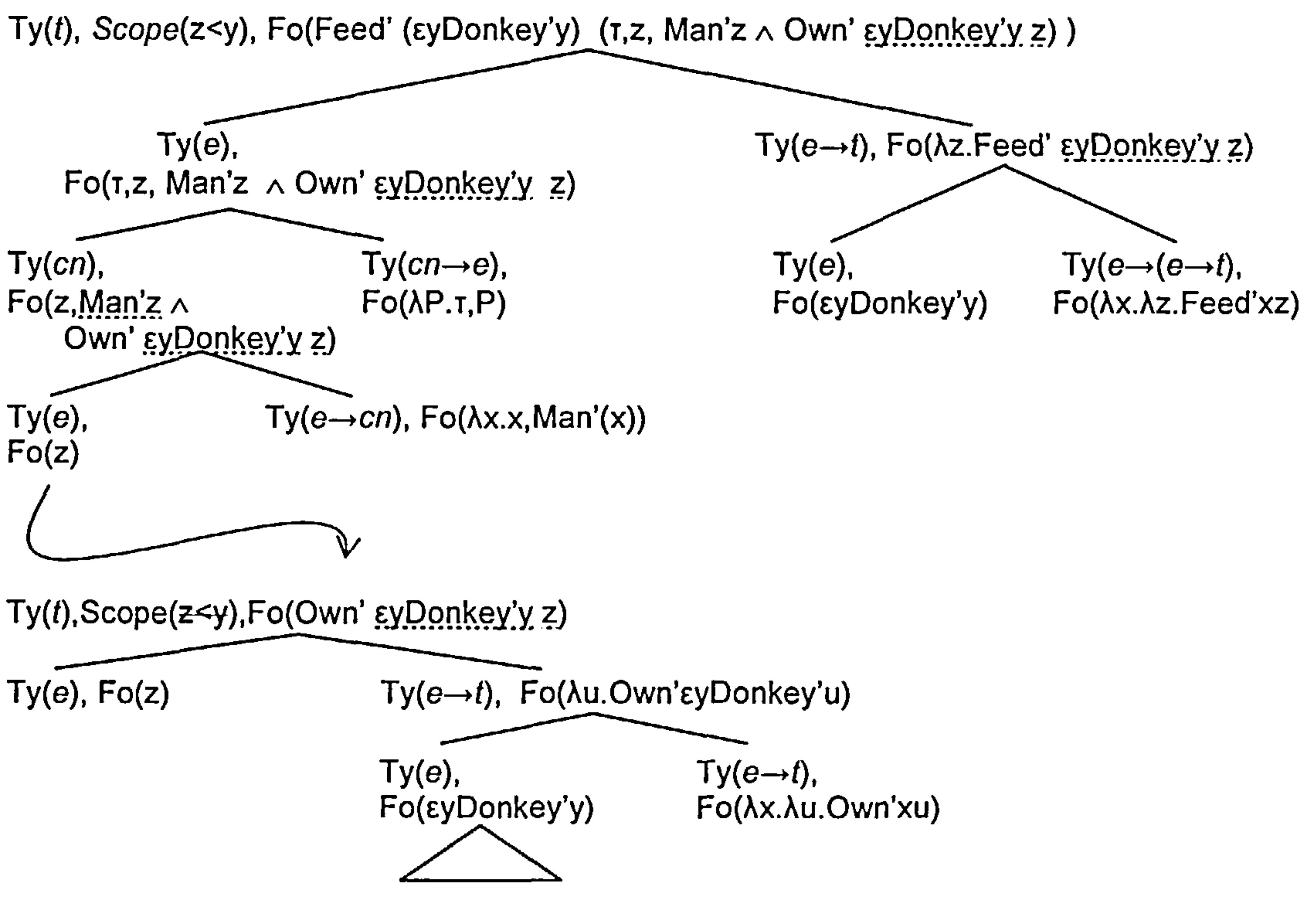
$$\begin{aligned}
 (c) \quad f_{Q \times \psi[v \times_n \psi_n/x_n]_n}(\varphi) &= (\psi[c/x])(\varphi[c/x]) \\
 &\text{where } c = v_Q x((\psi)(\varphi)) \\
 (d) \quad f_{w[x_1]}(\varphi) &= w[x_1]: \varphi.
 \end{aligned}$$

Applying the *Q-Evaluation Rule* to the formula in (84) will yield the following:

$$\begin{aligned}
 (86) \quad w_2: & (\text{Child}'b \wedge w_1: \text{Upset}'ba_b \rightarrow \text{Friend}'a_b \wedge \text{Cry}'b \\
 & \text{where } b = (\tau, z, \text{Child}'z \wedge w_1: \text{Upset}'za_z \rightarrow \text{Friend}'a_z \wedge \text{Cry}'z) \\
 & \text{where } a_z = (\epsilon, y, \text{Friend}'y \wedge \text{Cry}'z) \\
 & \text{where } a_b = (\epsilon, y, \text{Friend}'y \wedge \text{Cry}'b)
 \end{aligned}$$

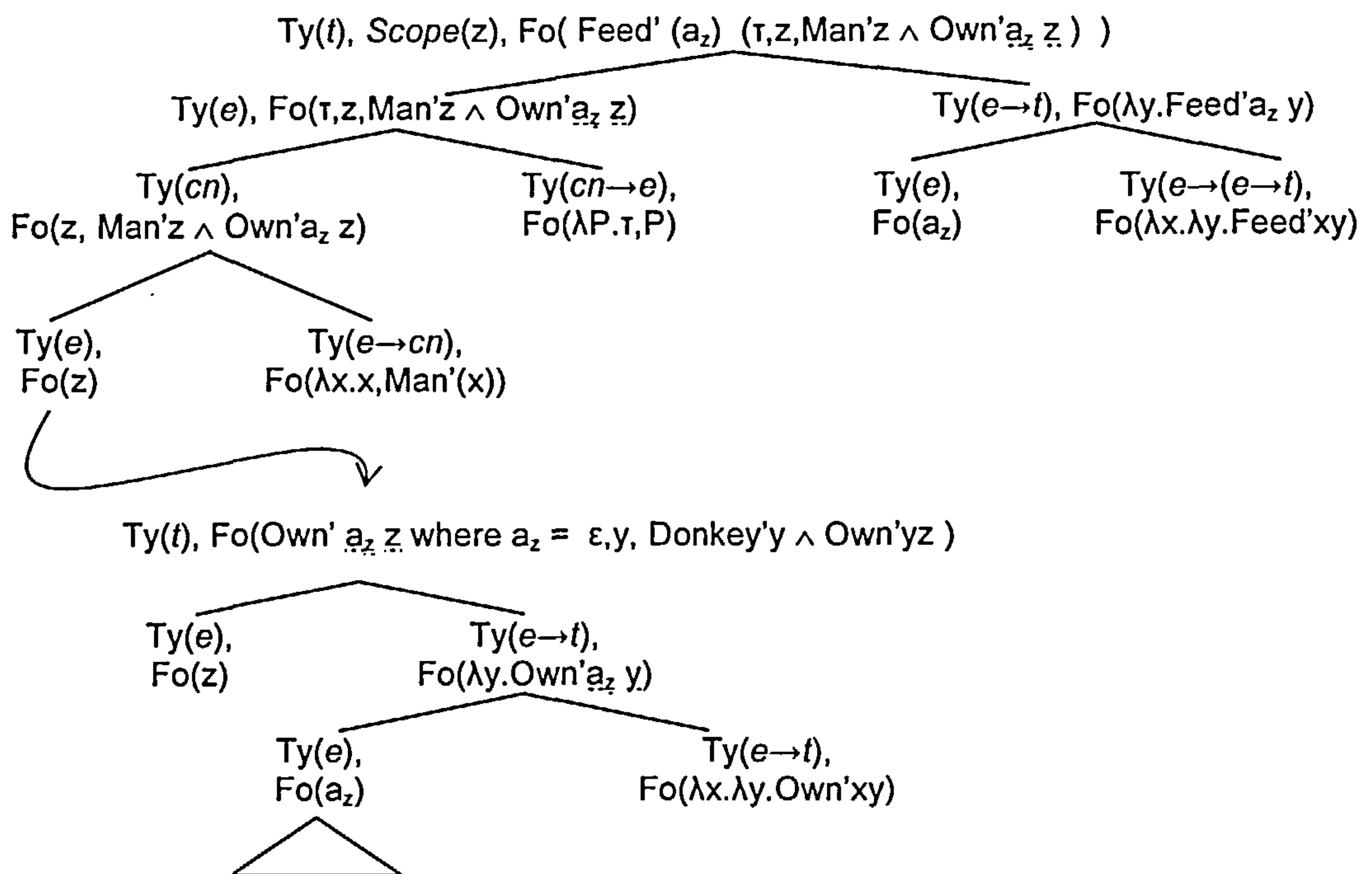
The same treatment can now be given to donkey sentences with universal quantifiers as the head and an indefinite contained inside the relative. According to whether the scope statement for the epsilon term representing the indefinite has been lifted or not, the metavariable contributed by the pronoun in the main clause will be replaced by either a complete or an incomplete term. The two alternative trees, first with a lifted scope statement and then with it in situ, are shown below¹⁷:

$$(87) \quad \text{Every man who owned a donkey fed it:}$$



¹⁷ For simplicity of illustration we omit the indices of evaluation as they do not affect the result.

(88) Every man who owned a donkey fed it:



The respective interpretations corresponding to each choice are as follows:

For (87) initially we derive the formula:

(89) $Scope(z < y), Fo(Feed'(\varepsilon y Donkey'y) (\tau, z, Man'z \wedge Own' \varepsilon y Donkey'y z))$

with Scope Statement: $Scope(z < y)$. After application of the *Q-Evaluation Rule* the derived formula will be:

(90) $(Man'b \wedge Own'a_b b) \rightarrow Donkey'a_b \wedge Feed'a_b b$
 where $b = \tau, z, Man'z \wedge Own'a_z z \rightarrow Donkey'a_z \wedge Feed'a_z z$
 where $a_z = \varepsilon, y, Donkey'y \wedge Feed'yz$
 where $a_b = \varepsilon, y, Donkey'y \wedge Feed'yb$

For (88) the resulting formula will be:

(91) $(Feed'a_z \tau, z, Man'z \wedge Own'a_z z \text{ where } a_z = \varepsilon, y, Donkey'y \wedge Own'yz)$

After the application of the *Q-Evaluation Rule* the formula will be transformed to:

- (92) $(\text{Man}'b \wedge \text{Own}'a_b b \rightarrow \text{Feed}'a_b b$
 where $b = \tau, z, \text{Man}'z \wedge \text{Own}'a_z z \rightarrow \text{Feed}'a_z z$
 where $a_z = \varepsilon, y, \text{Donkey}'y \wedge \text{Own}'yz$
 where $a_b = \varepsilon, y, \text{Donkey}'y \wedge \text{Own}'yb$)

The two formulas have equivalent predicate logic representations even though in DS there is a difference regarding the stage at which the epsilon term is evaluated.

Now we will look at how terms embedded inside conditionals can give rise to what in other frameworks are described as bound variable or E-type uses of pronouns (or, what, in DRT, motivates the definition of accessibility relations constraining the identification of referents). Since the issue is broader than donkey contexts we turn to the general problem that has been termed *quantificational subordination* or *telescoping*.

2.c.2. Quantificational Subordination: The DS solution

2.c.2.a. Accessibility of terms

In standard DRT and DPL the interpretation of universals makes use of the semantics/representation of implication with the result that antecedents for pronouns are only available in the direction from the antecedent to the consequent with everything else introduced inside the scope of the conditional inaccessible from superordinate positions. As we saw earlier, unlike classical DRT, Groenendijk and Stokhof (1991) a.o.¹⁸ consider the possibility of allowing the processing of universals and conditionals to be either externally static or externally dynamic in order to achieve the effects observed in the type of phenomena termed *quantificational subordination*, illustrated below:

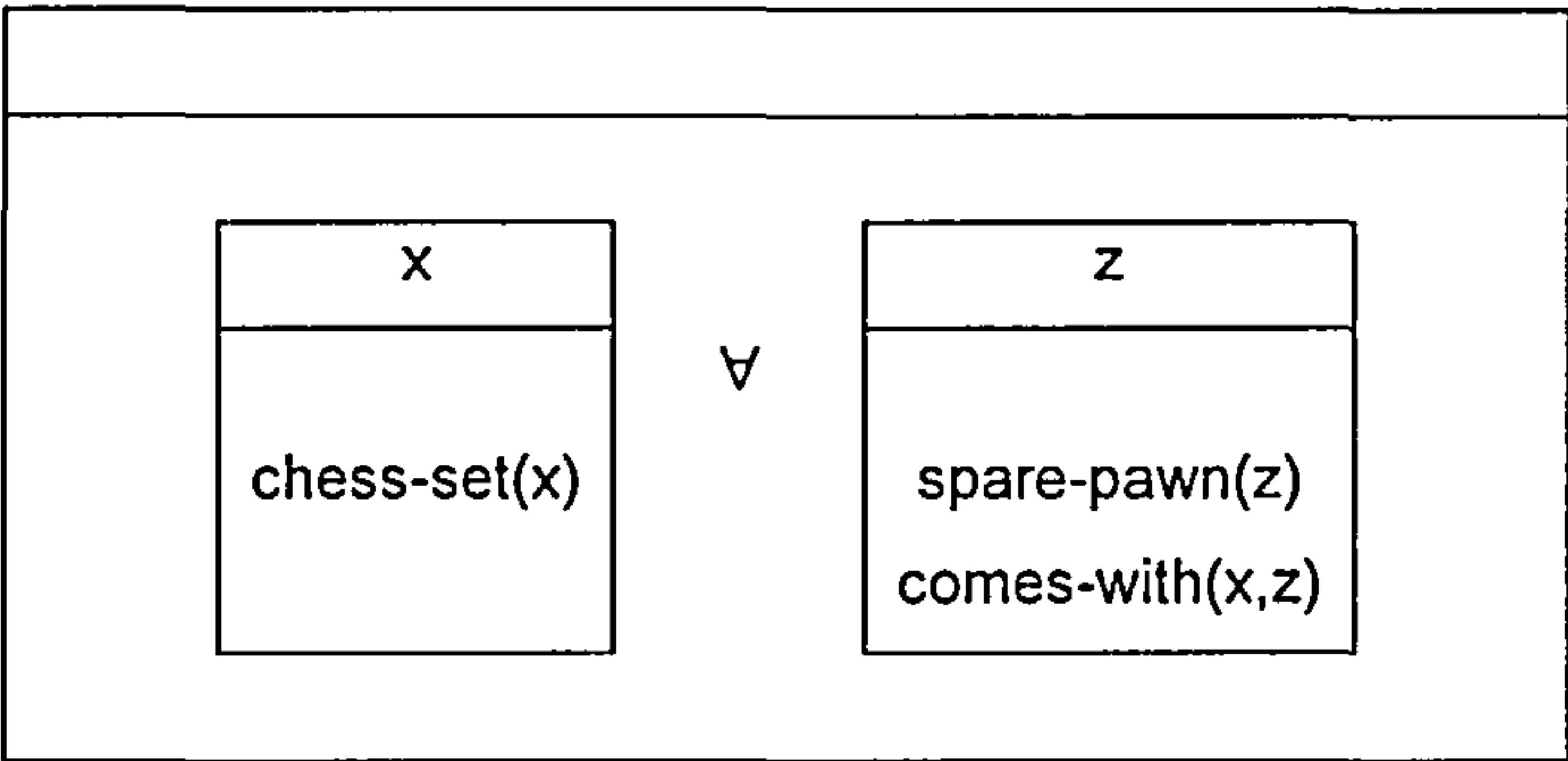
- (93) *Every student_i walked to the stage. He_i took his diploma from the Dean and sat down again.*
 (94) *Every chess-set_i comes with a spare pawn. It_i is taped to the bottom (of the box)*
(from Sells 1984)

¹⁸ see e.g. Fernando (1993).

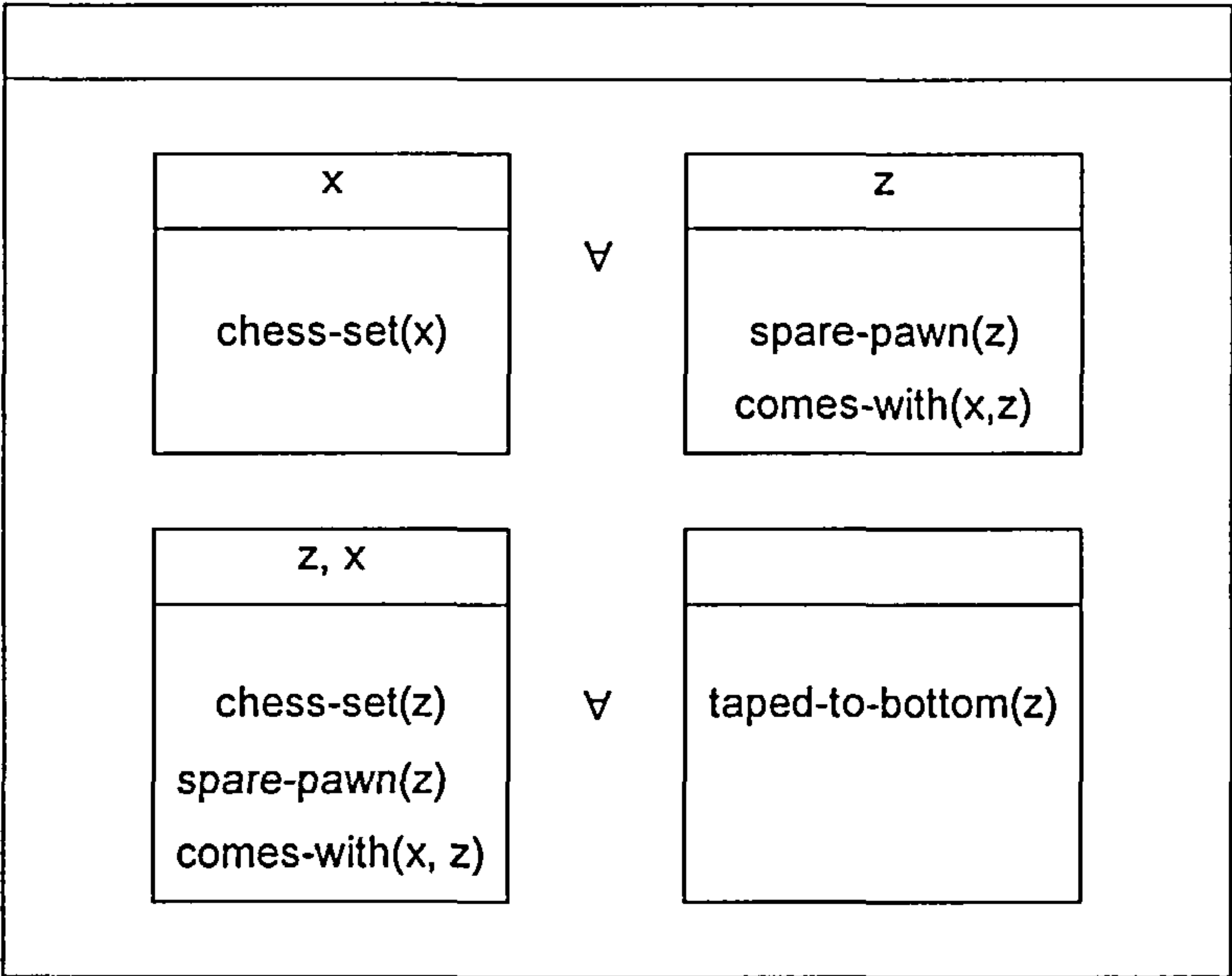
- (95) *Every British soldier_i aimed and then he_i killed an enemy soldier.*
(from Carminati et al. 2002)
- (96) *Every story_i pleases these children. If it_i is about animals, they are excited. If it_i is about witches, they are enchanted, and if it_i is about humans they never want it_i to stop* (Belvadi 1989)
- (97) John introduced *every new student_i* to the chairperson. Bill introduced *him_i* to the Dean (from Chierchia 1995)
- (98) *Fast jeder Stuhl_i, den wir gesehen haben, war echt schön.* *German*
almost every chair it we saw have was really beautiful
Leider war er_i auch viel zu teuer.
unfortunately was it also much too expensive
(from Shaer & Frey 2003)

For the same reasons Roberts (1989) employs the operation of *Accommodation*; this technique allows the extraction of information introduced inside the inaccessible domain of the conditional and its copying to a new domain where it serves the role of providing antecedents for anaphoric elements:

- (99) Every chess set comes with a spare pawn:



(100) It is taped to the bottom of the box:



Given the non-monotonic and non-compositional character of the Accommodation method it seems more appropriate to take it as an abstract description of the pragmatic processes that affect the interpretation of discourse. But if this is the case then Accommodation as an independent process can have no status in a grammar and would be superseded by general pragmatic/inferential principles, like the principle of relevance, which interact with grammatical encoded rules. For what concerns us here, since the circumstances that allow Accommodation have not been precisely defined, it is difficult to determine in a compositional way which portions of the discourse representation can and will be copied; therefore Accommodation cannot be incorporated in the grammar formalism either in the form of general computational rules or as part of specialised sets of lexical actions. It has been pointed out by Wang et al. (2005) that it is the discourse relations between propositions, derived pragmatically, that predict such felicitous accessibility of information to different domains. Since we agree with the *general spirit of this suggestion (although not with its implementation)* we will not attempt to provide here a discussion of how the appropriate context is

selected that makes terms introduced inside purported inaccessible domains available or that precludes such accessibility. A pragmatic approach like Relevance Theory provides the criteria and the method for achieving these results and, from the present point of view, the grammar formalism should only provide the structural means that underpin such choices. In addition, an argument against a special-purpose procedure for the handling of such cases comes from the psycholinguistic literature where there is evidence that, at least “quantificational subordination” cases are not processed any differently than normal “anaphoric” cases (see Carminati et al. 2002). Therefore, what we will be concerned with here is (a) modelling the means that make terms available when context dictates that they are needed, and (b) define the absolute structural restrictions that preclude such accessibility in all contexts.

2.c.2.b. DS modelling of quantificational subordination

2.c.2.b.1. Processing of juxtaposed clauses as subordinate

To start with, we take (93) repeated below:

- (101) *Every student_i walked to the stage. He_i took his_i diploma from the Dean and returned to his_i seat*

The predicate logic formula representing the interpretation of (101) is shown below (omitting irrelevant details):

- (102) $\forall x (\text{Student}'x \rightarrow \text{Walked}'x \wedge \text{Took-diploma}'x \wedge \text{Returned-to-seat}'x)$

The interpretation of the first sentence of (101) is as follows:

- (103) $\forall x (\text{Student}'x \rightarrow \text{Walked}'x)$

Following the rules defined by DS for the processing of (101) the following formula will be derived at the root node of the tree:

- (104) $\text{Walked}'(\tau, x, \text{Student}'x), \text{Scope}(\dots, x)$

This formula taken along with the Scope Statement is equivalent to (103). At this point, according to standard DS assumptions, we can apply the Q-

Evaluation Rule. After its application we will derive the following, which is also equivalent to (103) but which also makes available for copying the completed τ -term (abbreviated as a):

$$(105) \quad \text{Student}'(a) \rightarrow \text{Walked}(a) \text{ where } a = \tau, x, \text{Student}'x \rightarrow \text{Walked}'x$$

However, if we assume that this is the correct formula derived by processing the string in (101) we potentially get into trouble. We have to copy the completed τ -term in the tree derived as the semantic representation of the content of the second sentence of (101) as a replacement for the metavariable contributed by the pronoun *he*. But if we then apply the usual *Q-Evaluation Rule* for τ -terms we derive a formula with undesirable truth conditions:

$$(106) \quad \text{Took-diploma}'(a) \text{ where } a = \tau, x, \text{Student}'x \rightarrow \text{Walked}'x \xrightarrow{\text{Q-Evaluation Rule}}$$

$$(107) \quad \begin{array}{l} \text{Student}'(a) \rightarrow \text{Walked}'(a) \rightarrow \text{Took-diploma}'(a) \\ \text{where } a = \tau, x, \text{Student}'x \rightarrow \text{Walked}'(x) \rightarrow \text{Took-diploma}(x) \end{array}$$

The resulting formula could be true in a situation where some students did not walk to the stage and they did not get a diploma from the dean. However, in such a situation (101) is perceived as false since intuitively it states that *all* students walked to the stage. For this reason, Kempson et al. (2001) propose a more complicated rule for the restructuring of terms in such cases:

(108) **Q-Evaluation Rule:**

$$\frac{\langle \dots, \langle x_1 \dots, x_n \rangle, \dots, t \rangle: \varphi[v \ x_n \ \psi_n/x_n]}{\langle \dots, \langle x_1, \dots, x_{n-1} \rangle, \dots, t \rangle: f_{v_n \ x_n \ \psi_n}(\varphi)}$$

where for x occurring free in φ , the values $f_{v_n \ x_n \ \psi_n}(\varphi)$, for $v = \tau$ are defined by:

$$(a) \quad \begin{array}{ll} f_{\tau \ x \ \psi}(\varphi) = (\chi \rightarrow (\xi \wedge \psi))[a/x] & \text{if } \psi = \chi \rightarrow \xi \\ (\varphi \rightarrow \psi)[b/x] & \text{otherwise} \end{array}$$

$$\text{where } a = \tau \ x \ (\chi \rightarrow (\xi \wedge \varphi))$$

$$\text{where } b = \tau \ x \ (\psi \rightarrow \varphi)$$

However this rule, although giving the right truth conditions in this case, faces two problems: Firstly, the framework as currently defined does not allow re-evaluating terms once they are copied in a subsequent structure: application

of the *Q-Evaluation Rule* relies on a term's variable being in the Scope Statement; however, a copied term will not provide such a scope declaration; therefore the *Q-Evaluation Rule* cannot take this term into account. The second issue concerns exactly the fact that lack of a scope declaration for copied terms as provided by the currently defined rules provides the correct result by not allowing the term to be re-evaluated: If a copied term was allowed to enter the Scope Statement then it should be accompanied with the stipulation that it must necessarily take wide scope with respect to other terms in that tree. This is because terms copied to another structure should not be allowed to depend on other terms newly introduced there. For example, the following sentence:

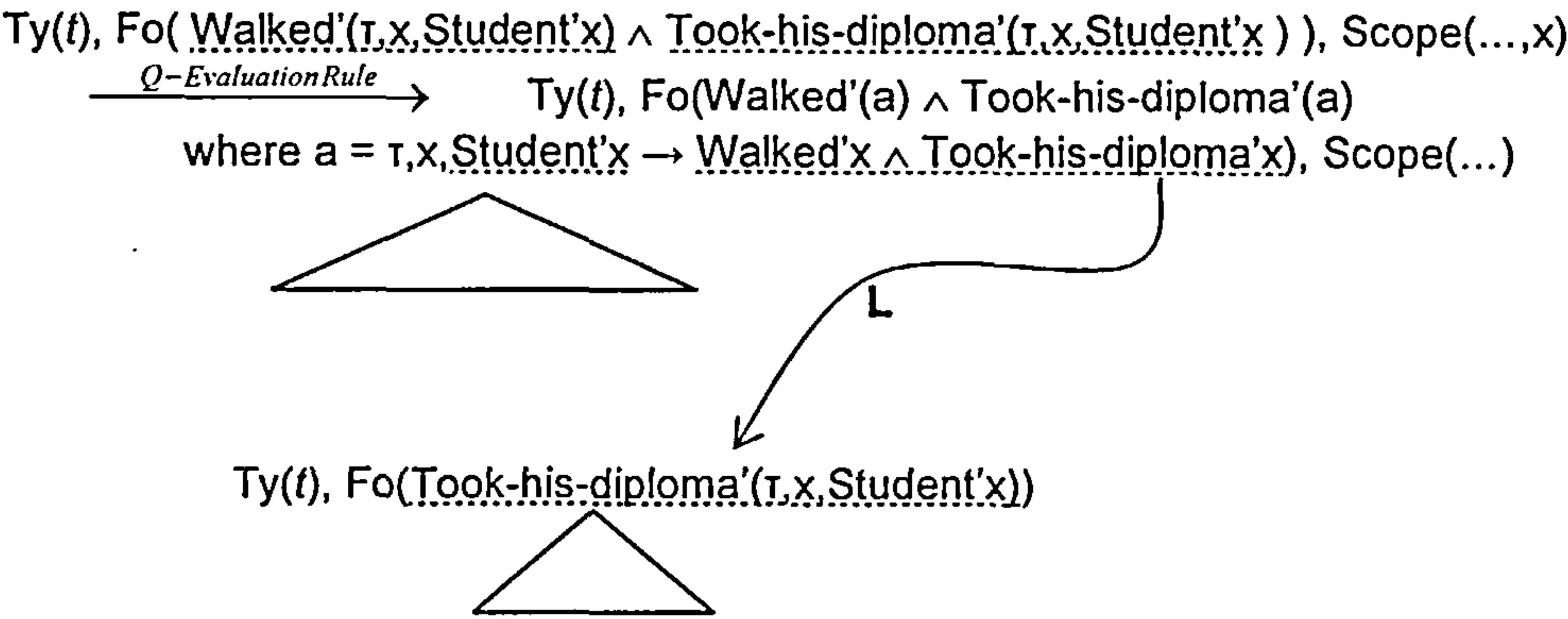
(109) A man came in. Every woman saw him.

cannot have an interpretation where for every woman there is a man such that he was seen by her. But if we allow the completed epsilon term to appear in the Scope Statement of the tree derived by parsing the second sentence we will have to stipulate that it necessarily has wide scope with respect to the τ -term derived from the universal. It seems that in that respect complete terms behave more like proper names (interpreted as rigid designators).

The solution to this problem can be given by assuming that in the *telescoping* cases in (93)-(98) above what is actually copied is an incomplete term, i.e. a term which has not been evaluated yet. This should give the right results in the cases involving universals and without the special *Q-Evaluation Rule* in (108) above. The assumption that we need to make to achieve this is that a LINK relation is initiated from the completed propositional node before the *Q-Evaluation Rule* has applied. We take as evidence for the validity of such a constraint regarding the telescoping cases the presence of a singular pronoun in the linguistic input which, from our perspective, indicates that indeed the incomplete τ -term has been copied. Such a term will not introduce a new Scope Statement declaration in the LINKed tree and will necessarily be evaluated at the main tree after the *LINK Evaluation Rule* (in (62)) has

allowed the pointer to return there. Here is a schematic representation illustrating the copied term and its eventual evaluation in the main tree:

(110) Every student walked to the stage. He took his diploma ...



We will see now how to achieve such representations for juxtaposed sentences.

We have assumed that the LINK connection among trees defines a single inferential domain (the *global tree*) which, in that capacity, serves as a scope extending device for terms. To model this intuition more appropriately we will now retract the multi-purpose *LINK Introduction Rule* shown in (60) and repeated below:

(111) **LINK Introduction Rule:**
IF Ty(X)
THEN make(<L>); go(<L>); put(?Ty(X))
ELSE abort

Instead we define LINK Introduction on a case-by-case basis with appropriate constraints in each case. This seems a reasonable assumption since *LINK Introduction* can take many forms: in relatives and, as we saw, in conditionals it can be introduced across languages either by specialised lexical items or specialised Computational Rules; on the other hand, in cases of coordination, it is the lexical input from *and*, *but*, etc. which provides the appropriate construction. In the case of interest, where we LINK two trees derived from two juxtaposed sentences, we have to assume that the only reason for doing so must be the desired correlation of interpretations (i.e. some type of

subordination) which will lead to the scope extension for terms. Otherwise, since the trees remain available in the *Discourse Context*, there would be no reason for such extension. Therefore we will make it a condition for the application of the *LINK Introduction* rule that the Scope Statement is still intact, i.e., the terms in the main tree have not been evaluated yet.

To implement this we introduce a new predicate which is satisfied only when the variables in the Scope Statement have been consumed by the *Q-Evaluation Rule*¹⁹. The new predicate introduced is called *ScEval* and is defined as follows:

$$(112) \quad T_n \models \text{ScEval} \leftrightarrow T_n \models \text{Ty}(t) \wedge \text{Scope}(\emptyset)$$

This predicate in the form of a requirement is needed in any case since currently there is no way to force the *Q-Evaluation Rule* to apply. We will therefore define a requirement *?ScEval* which is part of the *Axiom* and which will force the *Q-Evaluation Rule* to apply at the end of the parse. By exploiting the presence of this requirement, we can modify the (now specialized) *LINK Introduction* rule as follows:

$$(113) \quad \begin{array}{ll} \textbf{Propositional LINK Introduction Rule:} \\ \textbf{IF} & \text{Ty}(t), \text{?ScEval}, \\ \\ \textbf{THEN} & \text{make}(\langle L \rangle); \text{go}(\langle L \rangle); \text{put}(\text{?Ty}(t)) \\ \\ \textbf{ELSE} & \text{abort} \end{array}$$

This rule can only take effect if the *Q-Evaluation Rule* has not been applied yet since we assume that application of the latter immediately satisfies the requirement *?ScEval* which will be removed by *Thinning*. We will now see how this rule will allow us, in combination with some auxiliary assumptions, to parse successfully cases of quantificational subordination. We first examine the significance of the use of a plural vs. a singular pronoun in order to pick

¹⁹ We take the Scope statement to include a set of predications regarding the predicate \langle : $\text{Scope}(\{\langle(x,y), \langle(y,z), \dots\})$. We notate it as $\text{Scope}(x\langle y, y\langle z, \dots)$ for simplicity.

up a referent constructed by the parsing of a universal quantificational expression.

Although in the *epsilon calculus* ε - and τ -terms seem to be treated as duals, in systems of *Natural Deduction* the names used for eliminating universal and existential statements carry somewhat distinct notions of *arbitrariness* with the consequence that distinct conditions of use for these names have to be defined. As a result, for our purposes, it is natural to suggest that derivation of complete ε - or τ -terms has distinct inferential potential. We will firstly take for granted that copying of completed terms indicates that the inferential effects for that propositional domain have been derived and that the incomplete variants have been superseded and are no longer available²⁰ for copying. The common unavailability of universal quantifier expressions anteceding singular pronouns can be explained by taking into account what kind of existential “presuppositions” or inferences are associated with the use of a universally quantifying expression in a particular context:

- (114) # Every man_i bought a bike. He_i was pleased with it.
 (115) # If every student_i bought a bike he_i would be pleased with it.

A τ -term, after it has been evaluated, represents a set of entities rather than the set’s individual members²¹. Therefore a plural pronoun must be used to pick up this set:

²⁰ The incomplete terms must remain available for exceptional instances of substitution to deal with cases where revision is required. As has been pointed out by many researchers, it cannot be the case that the completed term is the replacement of the metavariable contributed by the first pronoun *he* in (ii) below as this would lead to inconsistency:

- i. A: A man fell over the cliff
- ii. B: He did not fall. He jumped

We can assume that in these cases what is copied in the second tree is the incomplete ($\varepsilon x \text{Man}'x$) rather than ($\varepsilon x \text{Man}'x \wedge \text{Fell-over-the-cliff}'x$). However, since such cases involve non-monotonic retraction of the derived content we do not have to define a grammatical process accounting for them here.

²¹ Epsilon terms also represent a set of individuals. However in this case there is no presupposition/inference carried that the set has more than one member. In contrast universal quantification in natural language “presupposes” both the existence of individuals satisfying the predication and the fact that there are a number of them (but note that this is not a hard-wired part of the meaning of *every* but rather a pragmatically derived effect).

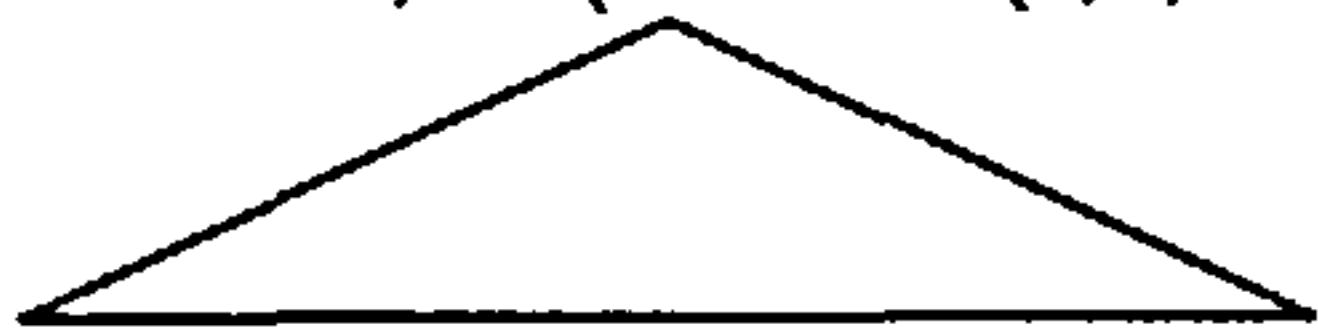
- (116) Every man_i bought a bike. They_i were pleased with it.
 (117) If every student_i bought a bike they_i would be pleased with it.

On the other hand, the presence of a singular pronoun in the telescoping cases indicates under present assumptions that a single individual standing for (a potentially empty) set is currently being used.

With these new assumptions we now return to the processing of (101) (repeated below). The resulting intermediate formula after parsing the first sentence will be as shown in (119):

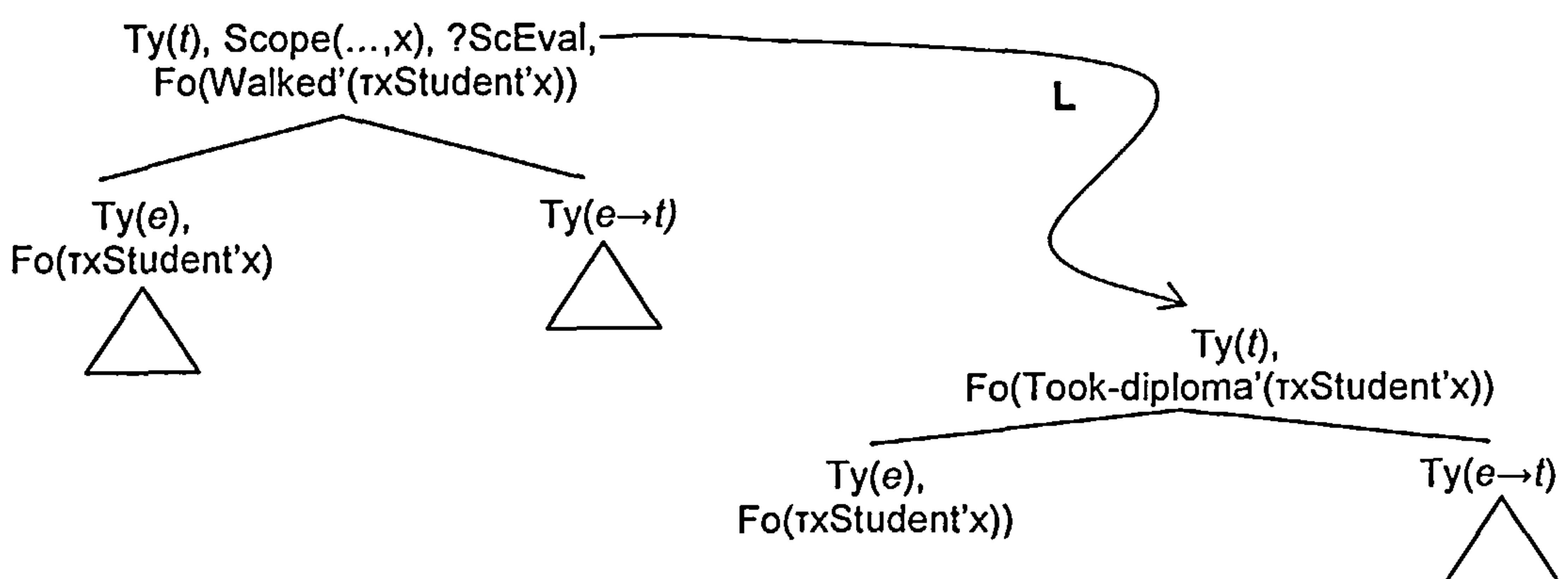
- (118) Every student walked to the stage. He took his diploma from the Dean and returned to his seat

- (119) $Ty(t), ?ScEval, Fo(Walked'(\tau, x, Student'x)), Scope(\dots, x)$



Now before evaluation of the τ -term we can apply the rule in (113) and attach a LINKed tree to the current node. This tree is going to accommodate the content of the second sentence of (118). After parsing of the second sentence with the assumption that the incomplete τ -term is copied there as the subject we derive the following schematic representation:

- (120) He took his diploma from the Dean \Rightarrow



The *LINK Evaluation Rule* can now apply and copy the formula decorating the top node of the LINKed tree to the root node of the global tree. This will give us the following formula at the top node of the first tree:

- (121) $Ty(t), ?ScEval, Fo(Walked'(\tau, x, Student'x) \wedge Took-diploma'(\tau, x, Student'x)),$
 $Scope(..., x)$

When we apply the *Q-Evaluation Rule* to the above we will get the following formula which shows the correct truth conditions (without having to modify the evaluation rule for τ -terms):

- (122) $Student'(a) \rightarrow Walked'(a) \wedge Took-diploma'(a)$
 where $a = \tau, x, Student'(x) \rightarrow Walked'(x) \wedge Took-diploma'(x)$
 $\leftrightarrow \forall x [Student'(x) \rightarrow (Walked'(x) \wedge Took-diploma'(x))]$

We now once more return to (94) repeated below in (123) and see whether it can still be processed successfully under our new assumptions. The predicate logic formula that represents the relevant interpretation of the first sentence is as shown in (124):

- (123) Every chess set comes with a spare pawn. It is taped to the bottom of the box.

- (124) $\forall x (Chess-set'x \rightarrow \exists y (Pawn'y \wedge Comes-with'(x, y)))$

Since in this reading the indefinite introduces a referent/variable inside the scope of the universal quantifier, it is predicted in classical DRT that the variable/referent will be inaccessible from the main DRS. However the continuation *It is taped to the bottom of the box* shows that such a referent can be available under certain circumstances. Wang et al. (2005) argue that quantificational subordination is easier with the discourse relations of *Elaboration* and *Narration* than with other relations such as *Result*, *Background* or *Commentary*. The relation between the two sentences in (118) above can be characterised as *Elaboration* so that the circumstances are right for the copying of an incomplete term to take place. As we said earlier we will not be concerned here with determining this type of restrictions (especially since encoding precise discourse relations in such a way seems particularly limiting in providing a basis for explanations, see Rouchota 1996). In fact, if we tried to base application of the *Propositional LINK Evaluation* on some encoded discourse relation we will derive incorrect results: even though the same discourse relation as above seems to hold between the two sentences in the following discourse the plural pronoun is equally appropriate:

(125) Every chess set comes with a spare pawn. They are taped to the bottom of the box.

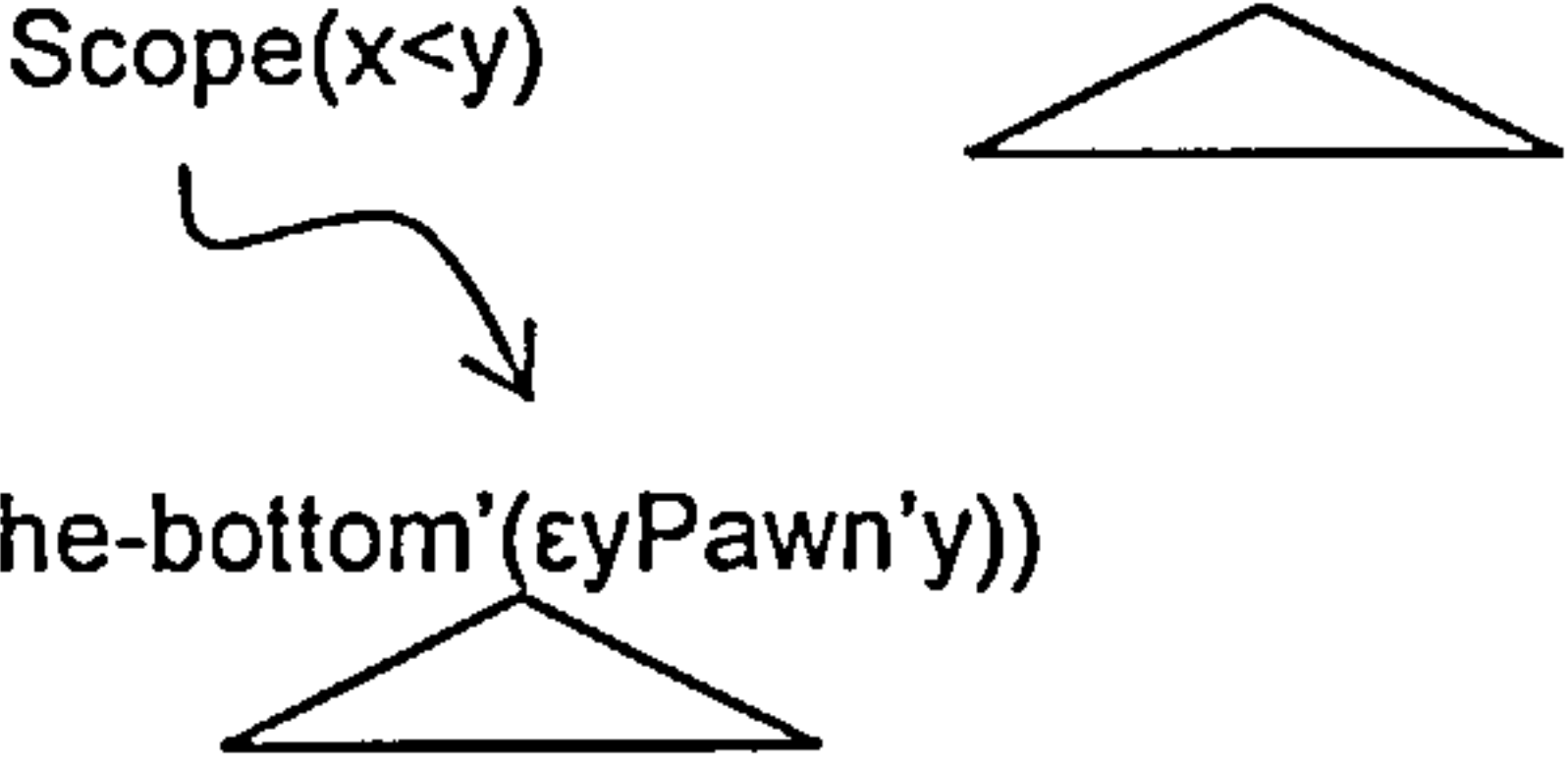
Under the current analysis, use of the plural pronoun indicates that there would be no LINK relation between the two trees and no copying of an incomplete term. Nevertheless the discourse relation remains the same so presence or absence of a LINK association cannot be mapped to a set of well-defined discourse relations. For this reason we have to make clear that what we are interested in modelling here is how an antecedent can become available through the processing of previous discourse regardless of its accessibility status due to the pragmatic circumstances. We will now show (briefly) how this happens.

The initial representation of the content of the first sentence of (94)/(123) is as follows:

(126) Comes-with'(τx , Chess-set' x , ϵy , Pawn' y), Scope($x < y$)

We can now assume that the *Propositional LINK Introduction Rule* applies and the parsing of the second sentence of (123) starts. The metavariable introduced by the pronoun *it* at the subject node can be replaced by the incomplete ϵ -term. After the *LINK Evaluation Rule* has applied we derive the following schematic representation:

(127) $Fo((Comes-with' \tau x Chess-set'x, \epsilon y Pawn'y) \wedge (Taped-to-the-bottom' \epsilon y Pawn'y)),$
 $Scope(x < y)$



$Fo(Taped-to-the-bottom'(\epsilon y Pawn'y))$

After application of the quantifier evaluation rules the following formula is derived which gives the correct truth conditions for (123):

(128) $(Chess-set'a) \rightarrow (Pawn'b_a) \wedge (Comes-with'b_a a) \wedge (Taped-to-the-bottom'b_a)$
 where
 $a = \tau x (Chess-set'x) \rightarrow (Pawn'b_x) \wedge (Comes-with'b_x x) \wedge Taped-to-the-bottom'b_x)$
 $b_x = \epsilon y, (Pawn'y) \wedge (Comes-with'yx) \wedge (Taped-to-the-bottom'y)$
 $b_a = \epsilon y, (Pawn'y) \wedge (Comes-with'ya) \wedge (Taped-to-the-bottom'y)$

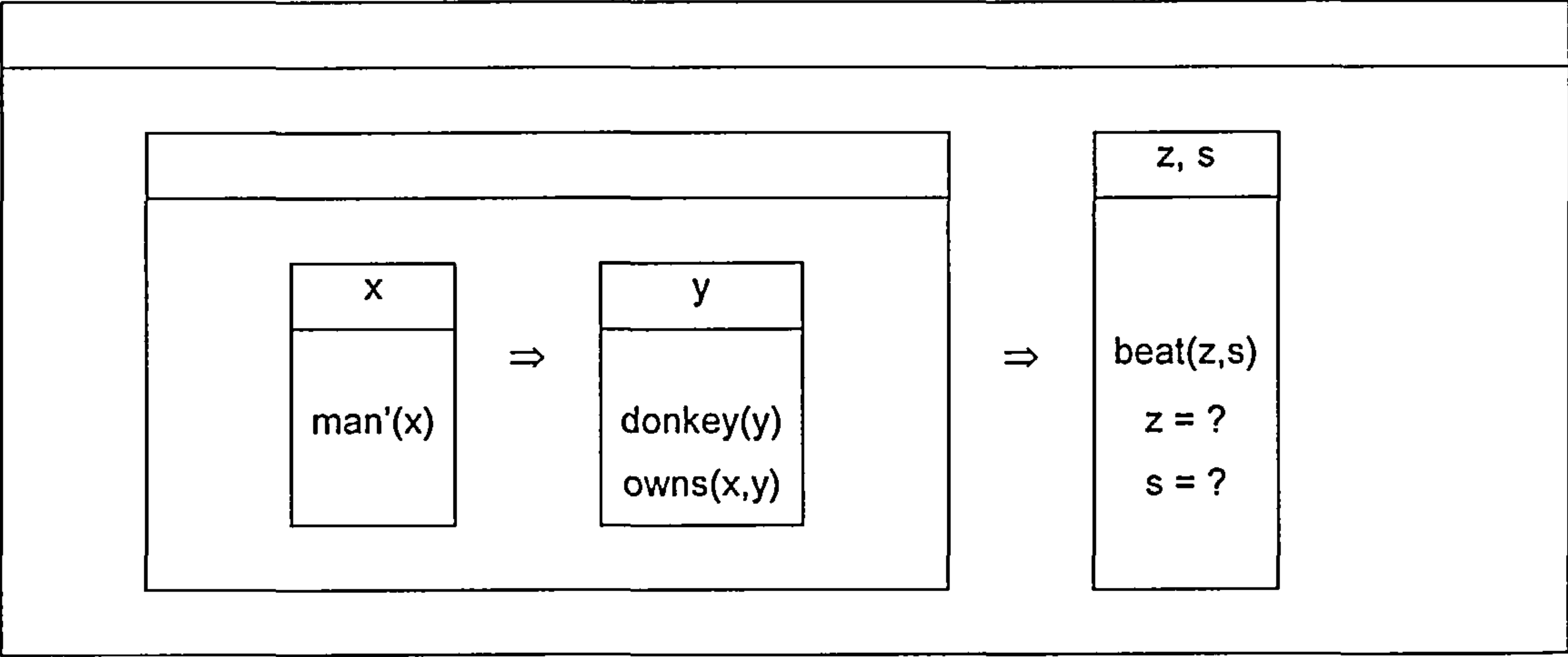
This concludes the processing of telescoping cases involving juxtaposed clauses. We will now turn to cases of quantificational subordination with conditionals and see whether the same tools can be utilised successfully. To start with we will see some new data which contradict standard assumptions regarding accessibility of referents and which we would also like to incorporate in our analysis.

2.c.3. Conditionals with anaphoric links between antecedent and consequent

2.c.3.a. Novel data

It has been standardly assumed that conditionals provide one of the clearest cases where distinct treatment of universal and indefinite expressions is justified. It is argued that a universal quantificational expression processed inside the antecedent of a conditional adds another layer of (in)accessibility so that the universal expression cannot be the antecedent for a pronoun in the consequent:

- (129) # If every man_i owns a donkey_k he_i beats it_k
- (130)



However this assumption does not seem to be verified if we look at the data more carefully. The following are attested examples culled from the texts found on the web (see Appendix 5 for full list, context, and sources):

- (131) ... If every choice is an opportunity, it's also a sacrifice...

- (132) So, if *every vote* counts, then *it* has to count in ALL counties- over and under votes.
- (133) Educational expenses could be paid out of a general fund that would give grants, low interest loans or scholarships. If *every student* were given a grant of \$5000 per year, then *he* could attend some type of school. If a more exclusive school were desired, then *he* could supplement the grant.
- (134) In the opposite case, one would also expect that if *every player* invests then *he* spends the largest possible amount of money $\bar{e} = \min_{i \in I} \{\bar{e}_i\}$ on each activity.
- (135) Funny -- if *every director* thinks he can do better than the writer, why doesn't *he* just do the writing himself instead of hiring a writer to give him a script to "improve upon"?
- (136) If *every man's* house is *his* castle, then *his* garden must be *his* retreat!
- (137) If *every indicted* knew he was indicted, *he* would have time to hide or destroy evidence.
- (138) ... even if *every spaceship* were made of diamonds, *it* would be cheaper in comparison with *its* virtual price.
- (139) Warren has this theory that if he faces *every shot* like it's a corner then he'll save *it* no problem . . .
- (140) ..., because if *every player* knew he would be going on the block at the end of every season, *he* would hustle his tail off and make it to every practice, ...
- (141) After his proposals failed to be included, Jefferson then concluded that if *every man* could not be a part of a militia, then *he* should be a part of the army.
- (142) We imagine - though we don't know for sure because they wouldn't let us on Little League - that if *every boy* doesn't want to play professional sports then *he* wants to own a professional team. Ex-Red Hat CEO Bob Young has realized that dream. He is now the new owner of the Tiger Cats, the football team in his hometown of Hamilton in Ontario.

These data refute the claim that universal quantifier expressions and indefinites behave so much differently with respect to anaphoric potential that they merit completely distinct treatments. Moreover, similar data also occur with other "proper" quantificational expressions and *when*-clauses (see Appendix 4-5 for full list and sources):

- (143) If *few electricity generators* have major market shares then they can execute market power and push prices above competitive levels..
- (144) In retrospect, I guess if *few programs/services* are *hardcoding 1*, then they are *wrong* and specifying bin or daemon equal to 1 would be worse.
- (145) If *most people* would simply 'eat right' then they'd get nearly all of the benefits.
- (146) If *most people* perceive the downtown as dangerous, then they will not spend time there, invest there, nor live there. Consequently, the downtown will suffer.
- (147) But that argument only goes to show how truly stupid Stupidity is. Here's how to counter it: if *most people* don't know the difference, then they won't object if you use the right word. And the few people who do know the difference will notice, and will be pleased that you've got it right. So by getting it right you please everyone.

- (148) *If most people accept the doctrines of socialism, then they will adopt socialism.* If they accept some fundamentalist religious dogma, then they will adopt theocracy.
- (149) If most of the looters are black, then they are black, and nobody can deny that.
- (150) Malvern Girls' College is situated in one of the most beautiful areas of Britain, at the foot of the Malvern Hills. Founded in 1893, the College enjoys a deserved reputation for excellent academic results. In 2005 the pass rate at A-Level was 99%, with 82% gaining Grade A-B. The College is committed to providing for the education of the whole person, so *when every girl leaves she is well-equipped* to fulfil her own individual potential with a sense of social commitment, responsibility and enthusiasm. The Head emphasises that the College caters for a wide range of ability on entry.
- (151) It's tradition that *when every witch turns 13, she must leave her family* and start on her own.

Therefore it seems that the DS stance of treating nominal expressions symmetrically makes the right predictions for these cases. All types of NPs can introduce terms which must be available for anaphoric purposes. The fact that in certain cases those terms do not seem to be available has to be attributed to contextual factors as discussed above (in this we concur with Wang et al. 2005). We turn now to a (schematic) illustration of the processing of such cases.

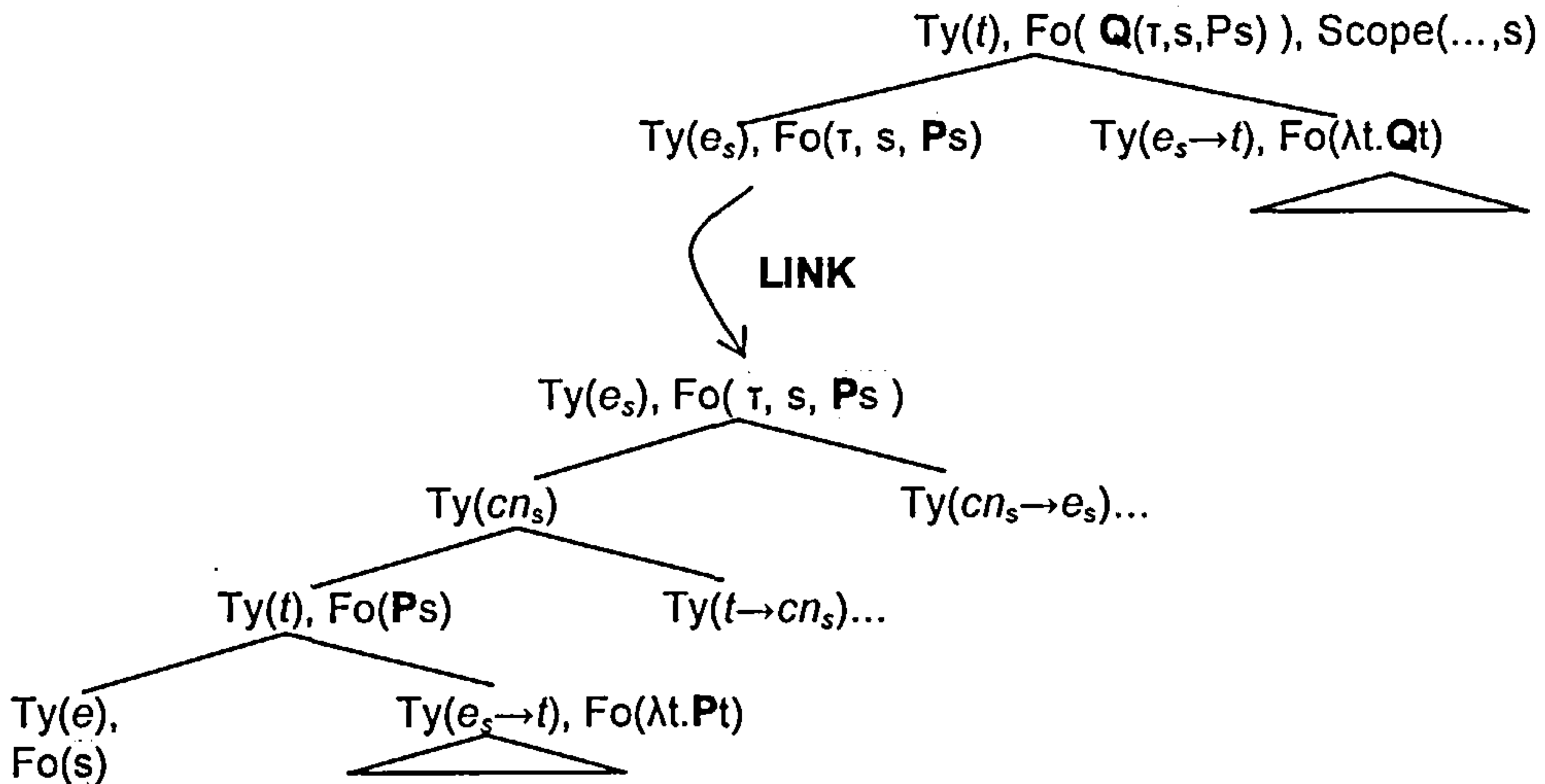
2.c.3.b. *Processing routine for conditionals with dependent universals*

Since the universal quantifier expressions provide the clearest case of scope extension under the previous assumption of scope subordination being indicated by the use of singular pronouns, we will take those as the paradigm case and present how their processing interacts with the processing of conditionals. We will present the analysis of (131) above repeated simplified below as representative of these cases:

- (152) *If every choice_i is an opportunity, it_i's also a sacrifice*

The analysis of conditionals in Chapter 4 presumes that the antecedent provides a LINK structure attached to the situation node of the tree constructed by the processing of the consequent:

- (153) The global tree *derived by processing if P, Q:*



Since the only purpose for the tree derived from the antecedent is to provide the situation argument for the main tree and since this situation τ -term is only constructed after processing of the lexical input of the antecedent has been completed we have made the natural assumption that the scope statement for the τ -term constructed out of the antecedent is generated at the topmost $Ty(t)$ node, i.e., at the root node of the tree that will accommodate the input from the consequent (this is ensured by instructions in the LINK Evaluation rule for conditionals see Chapter 4: (134)). Now in case some other term inside the antecedent is directly dependent on the situation variable we will make use again of the option of lifting its scope statement as exemplified earlier for relative clauses. Indeed the *Scope statement Lifting Rule* (repeated below) does not discriminate between relatives and other structures :

(154) **Scope statement Lifting Rule:**

$$\frac{
 \begin{array}{c}
 \{ \{ Tn(X), ?Ty(t), \dots \}, \\
 \{ \dots \{ MOD(Tn(X)), Ty(t), \dots, Scope(\dots z_i < x_i \dots), \dots, \diamond \} \} \}
 \end{array}
 }{
 \begin{array}{c}
 \{ \{ Tn(X), ?Ty(t), \dots, Scope(\dots z_i < x_i \dots), \dots \}, \\
 \{ \dots \{ MOD(Tn(X)), Ty(t), \dots, \diamond \} \} \}
 \end{array}
 }$$

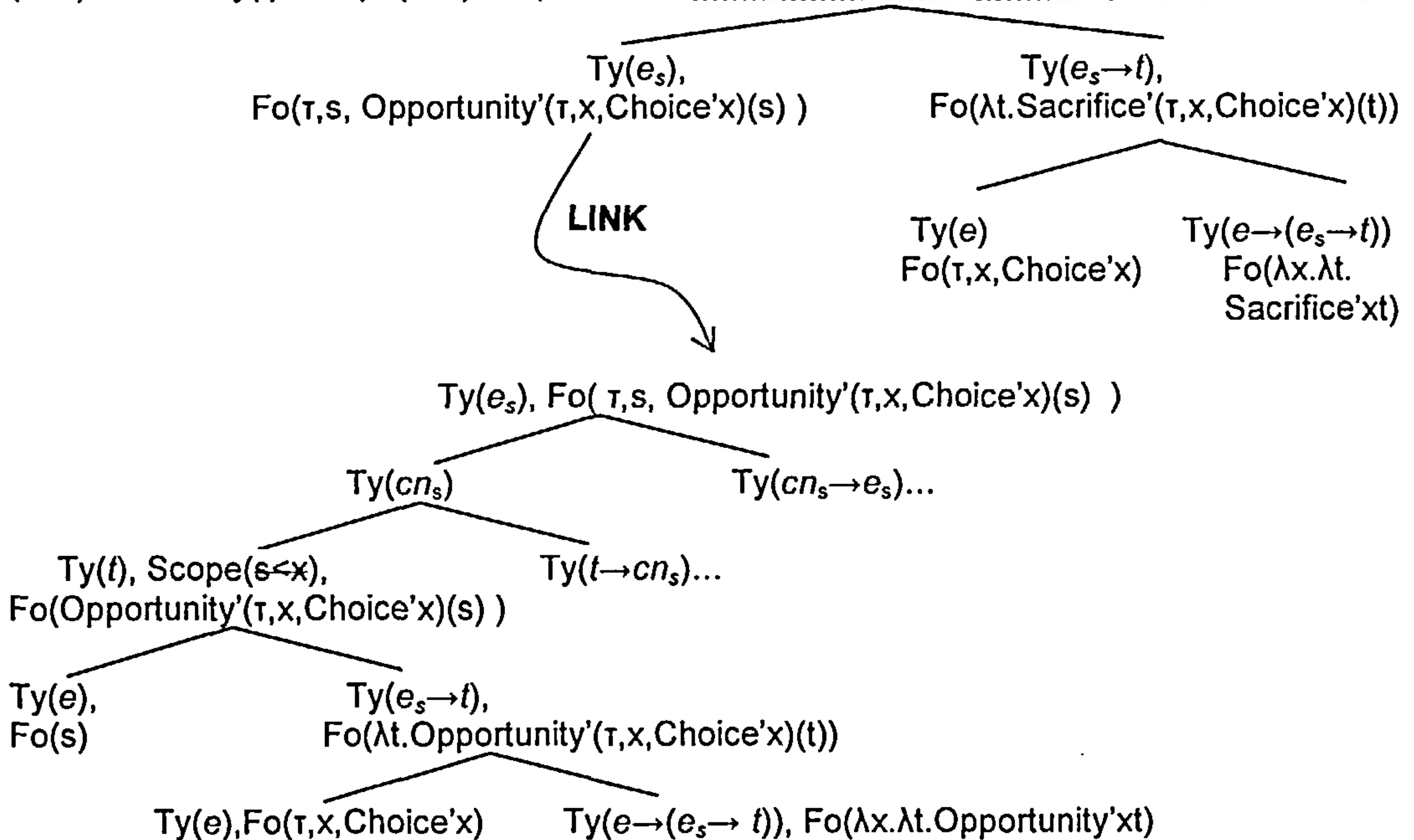
$MOD \in \{ <\uparrow_0>, <\uparrow_1>, <L^1> \}^*$

In the cases of interest where a τ -term derived from a universal quantifier expression is dependent on the situation argument, its scope statement can be transferred to the root node of the main tree (the consequent) and await its evaluation there. If that option is taken then the term available for replacing the metavariable contributed by a pronoun in the consequent can only be the

incomplete τ -term (note that scope statement lifting is optional and in fact it must be the dispreferred option given the processing delay that it causes; the term can perfectly well be evaluated with respect to the situation variable locally which will cause a dependency that will only become obvious at the topmost node). Here is an illustration of this option for (152):

(155) If every choice_i is an opportunity it's also a sacrifice \Rightarrow

(156) $Ty(t), Scope(s < x), Fo(Sacrifice' \tau, x, Choice'x \tau, s, Opportunity'(\tau, x, Choice'x)(s))$



The *Q-Evaluation Rule* can now apply to the topmost node's Formula value to derive the completed semantic representation:

(157) $Fo(Sacrifice' \tau, x, Choice'x \tau, s, Opportunity'(\tau, x, Choice'x)(s)), Scope(s < x)$

$\xrightarrow{Q-Evaluation Rule}$

(158) $Opportunity'(a_b)(b) \rightarrow Choice'(a_b) \rightarrow Sacrifice'(a_b)(b)$
 where $b = \tau, s, Opportunity'(a_s)(s) \rightarrow Choice'(a_s) \rightarrow Sacrifice'(a_s)(s)$
 $a_s = \tau, x, Choice'(x) \rightarrow Sacrifice'(x)(s)$
 $a_b = \tau, x, Choice'(x) \rightarrow Sacrifice'(x)(b)$

These data which, to our knowledge, are highly problematic for any current linguistic theory that deals with discourse anaphora have been dealt with in the DS analysis with the minor modification of allowing scope statements for τ -terms to be lifted if they depend on a term which is to be evaluated at a

higher node. The latter assumption also handles the *extrawide scope* cases like the following from Farkas & Giannakidou (1996):

- (159) A student made sure that *every invited speaker* had a ride.
- (160) (In general,) a guide ensures that *every tour to the Louvre* is fun
- (161) Yesterday, a guide make sure that *every tour to the Louvre* was fun

This concludes our account of donkey sentences, quantificational subordination/telescoping and finally quantifier “binding” effects across the antecedent and consequent of a conditional. We have provided a uniform account that covers all three types of phenomena. We were able to provide this analysis because of the simple assumption embodied in DS that all quantificational expressions provide LOT terms that have the status of the arbitrary names used in systems of Natural Deduction. Such names, once derived by the processing of linguistic input, can then be naturally taken to serve as replacements for the enrichment of the incomplete conceptual content provided by pronouns. Internally to a set of trees associated by LINK relations (a *global tree*) such names can be utilised as replacements even before they have been fully completed and evaluated. Such use will derive the effect described in static frameworks either as “bound variable” or E-type interpretations. Donkey sentences, either involving conditionals or relative clauses, can be treated without any further assumptions besides the non-configurational DS account of scope. This approach to quantification and anaphora predicts the existence of examples which in other frameworks have been considered either as requiring special provisions for their treatment (see e.g. (93)-(98) and Appendix 4) or as ungrammatical (as in (131)-(151) and Appendix 5). However, we have seen here firstly that the predicted “ungrammatical” instances do in fact occur in actual discourse and given the appropriate context and that a uniform account of all such cases can be maintained without special provisions.

CONCLUSION

In the previous chapters we saw how the formal apparatus defined in the framework of *Dynamic Syntax* (Kempson et al. 2001; Cann et al. 2005) for the processing of nominal relative clauses can be straightforwardly applied in the modelling of the processing of conditional structures. All central notions of DS have remained unchanged under this extension. Firstly, the DS account of anaphora as copying of available terms has been exploited in order to explain the semantic properties of conditional sentences: a newly introduced situation term constructed by processing the protasis is copied into the structure induced by the processing of the consequent in order to serve as the situation argument there. Additionally, it has been shown that exact parallels can be drawn between the semantic structure that can be assumed to underpin *if*-clauses and nominal terms. For this reason, the present account was able to employ in the analysis of *if*-clauses all the processing means that DS makes available for phenomena affecting the left and right periphery of the clause, initially defined solely for the processing of nominal phrases. From this perspective, the fact that a single semantic representation is achieved by means of parsing several distinct surface forms is attributed to the distinct processing means which are made available for building interpretations, not to multiple levels of structural analysis. The distinct inferential properties of each surface structure can then be seen not as properties of multiple structural representations but as the result of the interaction between the parsing dynamics and context dependent reasoning. An extension to the DS toolbox in order to deal with *cataphoric phenomena* in conditionals and *reconstruction* environments has been proposed. Finally we saw some new data which call for a reconsideration of the analysis of the phenomenon of *Quantificational Subordination*. We demonstrated how fundamental DS assumptions predict the existence of such data and provided the parsing routines for handling such cases appropriately.

Of course we do not pretend that we have exhausted all the issues that affect the processing of conditionals. There are many problems that await further research. The relevance-theoretic assumptions informally utilised here should be explored further in a more formal and precise way in order to determine whether they provide the appropriate semantics/inferential effects in combination with the DS account. The DS theory of tense, aspect and modality, partly handled in Perrett (2000), needs to be reconsidered in order to accommodate the assumptions made here. A compositional account of the processing of structures involving *even if* , *only if* and *unless* remains to be given (see e.g. Lycan 2001, Geis 1985, Iten 2002). In general, the present account should be extended to the processing of other adverbial clauses and a general theory of adverbial adjuncts should be provided compatible with the assumptions in Marten (1999). All in all it feels as if we have only scratched the surface of what might prove to be a lifetime project of research.

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APPENDIX 1

Non-Restrictives With Quantifiers

- (1) In contrast to most arthouse films, which tend to attract an older, upscale audience, 'Amelie' is playing to a slightly younger audience, which augurs well for it.
http://www.pipeboost.com/Demo/MSNBC_Article1.htm as retrieved on 18 Apr 2005 20:25:00 GMT
- (2) One quibble -- the portrait of a junior officer serving as the deputy spokesperson of a major embassy struck me as not very representative of the experience of most junior officers, who are more often assigned to visa work for their first couple of jobs. That said, I still found her story interesting. On balance, I found this to be a very educational and entertaining book that deserves to be widely read. Has anything this good been written about the Canadian diplomatic service?
http://www.afsa.org/inside/feedback_p2.cfm as retrieved on 3 Jul 2005 12:12:35 GMT
- (3) Holbek could not of course make use of such performance data, as he was working with texts collected in nineteenth century Denmark, a period when most collectors (who of course lacked modern recording methods) habitually omitted or excised materials not felt to be part of the text proper. Mrs Kerfont's comment validates a sexual reading of this and other symbols.
www.extenza-eps.com/WDG/doi/abs/10.1515/fabl.2003.001 as retrieved on 6 Jul 2005 22:13:34 GMT
- (4) The arrangements for this hearing will have taken more time than the story tends to suggest, but Suetonius' point is that Claudius made a quick decision (*confestim*), not that the whole problem was resolved quickly. This is the reading offered by most scholars, who of course assume that *cognitio* and *ius ordinarium* constitute distinct legal systems. But even on this view the logic is problematic: either the litigants objected to the judge on the general principle that anyone with a pending lawsuit should be ineligible to act as judge, or (as is more likely) they objected because the lawsuit in question was one in which the judge himself was their opponent. In either case, it is not clear how the judge's reply -- that the lawsuit at issue was scheduled for a different court system -- could possibly have been satisfactory.
<http://www.ulg.ac.be/vinitor/rida/1999/TURPIN.pdf>. as retrieved on 17 Jun 2005 12:00:14 GMT
- (5) About 80 percent of the irrigation in Nepal is provided through systems designed, built, and operated by farmers at their own initiative with minimal government involvement. Often the construction is carried by few wealthy individuals who then recoup their expenses by collecting funds from farmers of the newly irrigated land who then own and operate the system. The Chattis Mauja system is an example of the extent and sophistication, both technically and organizationally, of such irrigator-managed systems. Constructed about 50 years ago, it irrigates over 7,500 acres of land cultivated by farmers in fifty-four villages. It is managed by them through a three-tiered organizational structure with fifty village communities at the base, nine area committees, and a central committee. There is even an informal fourth-tier organization in that the Chattis Mauja central committee consults with representatives of three other user-managed systems that also draw water from the Tinau river.
<http://magnet.undp.org/Docs/dec/monograph/PopularPartic-NEP1.htm> as retrieved on 30 May 2005 16:17:59 GMT
- (6) One difference I noted was that, in this war, the American soldier is a technological wonder. Nearly every soldier owns a laptop, which he or she uses to play games or exchange e-mails from home.
http://www.staugustine.com/stories/022104/opi_2142736.shtml as retrieved on 7 Jul 2005 06:31:48 GMT
- (7) 7. Try Guerrillas Tactics From China to Cuba to Vietnam history teaches the power of a guerrilla movement. Weak forces can flourish if they take up a guerrilla stronghold and

resist being drawn into the open. Guerrillas are not organized like regular soldiers. The U.S. went into Vietnam with thousands of cooks, bakers, clerks, chauffeurs, chaplains and public relations officers. The smaller force of guerrillas had none of these, but virtually every soldier had a gun, which he used. A lean guerrilla organization can make quick decisions, seize opportunities and fill voids. A guerrilla force does not have the resources to waste on a lost cause. It does not hesitate to give up a position and move elsewhere—a flexibility envied by more entrenched forces (Reis and Trout, 1986).

Selected References Bevin, Alexander. *How Great Generals Win*. New York: Norton, 1993. Clausewitz, Carl von. *On War*. Edited with an introduction by Anatol Rapoport. 5. Manage Momentum

<http://www.cfar.com/cf/index.cfm?fuseaction=Publications.PublicationTracking&intPublicationID=75>. as retrieved on 9 July 2005: 17:56 GMT

- (8) Voter turnout will be maximized by hands-on GOTV efforts. GOTV should be more than signing up voters leading up to the election, it should be about energizing voters NOW. What better way to maximize this than to have a consistent message passed to every county chair, who then passes it on to every District chair, who then passes it on to every block captain, who then discusses it with their friends and neighbors at the park, the pool, the coffee shop, the diner. This takes very little resources once a consistent message is decided upon and the chain starts. It just takes a little energy at the roots, and we know how much energy our roots have!

<http://www.ncdp.org/node/413> as retrieved on 13 Jun 2005 18:52:49 GMT

- (9) Each demonstration write-up consists of concepts that can be taught, materials needed, set-up and demonstration procedures, questions to discuss with the students, and detailed explanations as to how and why the demonstration worked. It is my hope that the questions and explanations have been written in a manner that the junior high students can understand. Without teaching that age group, it is difficult to know for certainty what kinds of questions they may have. Hopefully, the questions and explanations will be understandable to every teacher, who then can use the information in a way that their students can understand it.

<http://htdconnect.com/~chargers/chemhome.html> as retrieved on 8 May 2005 09:46:31 GMT.

- (10) It is God's life-changing power that is able to touch every individual, who then has the responsibility to touch the world around him with the absolutes found in the Bible. In the end we must realize that the spirit of the age - with all the loss of truth and beauty, and the loss of compassion and humanness that it has brought - is not merely a cultural ill. It is a spiritual ill that the Truth given us in the Bible and Christ alone can cure.

<http://razorskiss.net/wp/?p=106> as retrieved on 7 Jun 2005 04:01:26 GMT

- (11) The land was not owned by individuals -- it was regarded as a sacred gift from "Umvvelinqangi" (the Creator) and as an asset for all members of the extended family to use and produce food for the whole family. Fifteen year old teenagers were allocated small pieces of land called "Isife" and were allowed to decide what they would like to grow. The colonizers, in their efforts to create scarcity in order to dominate the nation - they came and forcibly channeled the country's wealth i.e. land and natural resources to few white settlers who then had power over the majority of the indigenous people. Impact of globalizations on women is devastating: rather than eradicate poverty in the African countries, globalization have contributed to further sinking the countries into economic crisis. South Africans have witnessed:

- * Trade liberalization
- * Privatization
- * Decrease in social expenditure
- * The gap between policies and implementation.

<http://www.gifteconomyconference.com/pages/Sizani.html> as retrieved on 12 May 2005 21:36:00 GMT

- (12) One of the greatest challenges of gender mainstreaming seems to be the "Equality paradox" of the Finnish context. As the Finnish equality legislation is quite advanced, there seems to be no conspicuous need for enhancing equality issues (even if the vertical and horizontal segregation of labour markets still prevails). In principle, the politicians and high officials speak for gender mainstreaming and they are even proud of the equal

status of Finnish women and men, when the issue is presented abroad, but in the normal praxis of the department, it is difficult to take up gender questions without being labelled as a "feminist" or something equally negative. Matters dealing with equal opportunities seem to get piled up with few persons, who then get burned out. The other consequence is that the tone and content of the prevailing discourse is gender neutral.

http://www.skk.uit.no/VV99/papers/Horelli_Liisa.pdf. as retrieved on 17 Jun 2005 18:09:22 GMT

- (13) Employers could enroll their workers in a health insurance purchasing cooperative (HIPC).²³ One HIPC would be established for each of four designated geographic areas in the state, and each HIPC would offer all of the certified health plans in its area to every enrolled worker, who then would have to choose one of these plans.

<http://www.heritage.org/Research/HealthCare/BG1121.cfm> as retrieved on 11 Jun 2005 14:34:26 GMT

- (14) At the celebration of the completion of a Sefer Torah, this central point of Jewishness is revealed in each and every Jew, who then acts in the mission of ...

<http://www.sichosinenglish.org/books/sichos-in-english/12/15.htm> as retrieved on 3 Mar 2005 06:11:30 GMT

- (15) It is God's life-changing power that is able to touch every individual, who then has the responsibility to touch the world around him with the absolutes ...

<http://razorskiss.net/wp/?p=106> as retrieved on 7 Jun 2005 04:01:26 GMT.

- (16) 12:02PM - OK, here's the deal. Some people really get off on those cheerful, ironic, peppy Canadians calling themselves the Barenaked Ladies. Brandon- err, Jason Priestley, the Biff dude from 90120, liked 'em so much he directed a full-blown movie for them. The band had a few jingles that got picked up on the Alternative Radio, which basically means Columbia or Sony or whomever owns their mortal souls, jammed about half a mil into every A&R guy who then jammed \$50 and a line of blow into every regional Program Director at every Alternative Radio Station (which basically equates to, in my opinion, some bald 40-year-old middle manager pulling a fax of Acceptable Songs off a fax and typing them into the DJputer) and thusly we were subjected to their peppy happy jingles every waking second of the day. Now, one of their happy jingles made its way into a Mitsubishi commercial (You know, the peppy song that starts by some nerd saying "Eyyyyyyyyyit's been...") and is on heavy HEAVY rotation throughout the 50 states on every major TV channel. Let me be clear: I don't like the song. I like even less that it plays at least twice each hour.

<http://www.billdugan.com/log/2001/oct/> as retrieved on 1 Apr 2006 14:53:46 GMT.

- (17) Northanger Abbey

Chapter 3

Every morning now brought its regular duties — shops were to be visited; some new part of the town to be looked at; and the pump-room to be attended, where they paraded up and down for an hour, looking at everybody and speaking to no one. The wish of a numerous acquaintance in Bath was still uppermost with Mrs. Allen, and she repeated it after every fresh proof, which every morning brought, of her knowing nobody at all.

<http://www.pemberley.com/etext/NA/chapter3.htm>

- (18) **Date Posted:** 03:40:05 02/23/00 Wed

Author: Anonymous

Subject: Topaz Posting from WF

Subject: Wantoks forum admin Steven Kami purposely covers up the truth - EMMANUEL TOPAZ

In fact Kami allows the mild criticism that most students post because it resembles free speech and throws most students off balance who then become critical when one or two of them question the objectivity of the forum administrator. Kami was unprepared that his forum would be used by some to voice criticism and give evidence of corruption against his friends and employers and has found himself in a difficult situation. Instead of coming clean as his father would have told him and tell the forum audience what pressure he faces as well as his special interest in protecting his ghost law firm who has bankrupted countless national lawyers he continues to worry about his paycheck hiding behind the mask of forum administrator and putting out the bush fires as needed.

<http://www.voy.com/5575/552.html> as retrieved on 10 Jun 2005 13:07:31 GMT

- (19) Dr. McCormack announced that it was time to identify two representatives from each Advanced Concentration to serve on the Recruiting Committee. This is a group that will discuss the recruiting procedures and make phone calls to some of the prospective applicants. Also, we need two representatives from each Advanced Concentration for the Admissions Committee. The Admissions Committee has a bigger workload; they preview every completed application, which then gets read by four Committee members. For the Admissions Committee, there are a couple of meetings in December and for January through April we'll meet every week (usually Thursday afternoon starting at 1:00 PM until whenever we finish). Dr. Baker suggested that the Chairs provide us with a list of people they would be willing to assign to this Committee and then we could contact them to ask them if they would be willing to serve. Dr. Sumners agreed it would be a good idea. Furthermore, Dr. Sumners pointed out that on our web page we have a list of mentors who have said they would be willing to have someone in their lab, and he suggested they should also be willing to serve on this Committee.
<http://idp.med.ufl.edu/ADVISORY/2000-0928.htm> as retrieved on 30 May 2005 23:04:31 GMT.
- (20) Suicide attempts. The unrelenting physical debilitation has caused cruel isolation and loneliness, and sometimes caused me to act in desperate ways. Often, I feel I can no longer continue. On several occasions my husband found me in the early morning hours, sitting on the floor sobbing, with a loaded gun in my hand. Thankfully, I didn't carry out the act, because I know God has a plan for each of us. Sorrowfully, with every passing day which then turns into years, the temptation to again attempt suicide remains. I am completely debilitated and my life is a living hell.
http://www.fda.gov/ohrms/dockets/dockets/00n_1665/emc000007.txt as retrieved on 4 Dec 2004 23:07:10 GMT.
- (21) Overspecialization of knowledge, on the one hand, brought about a scientific/mathematical *esotericism* that is inaccessible to the general public and at times divorced from reality, and on the other hand, effected the truncation of the function and the purpose of business. Neo-Tech, through its full integration of philosophical principles, reveals a stunningly new picture of the universe and opens a new path of science that is not only free of Platonism (a divorce from reality) but also will bring a new revolution/evolution of scientific knowledge that is accessible to every conscious being, which, then, in turn will make possible the world-wide realization of highly advanced technological societies and scientific literacy.
<http://www.neo-tech.com/zero/part8.html> as retrieved on 1 Feb 2005 08:00:51 GMT
- (22) There is no evidence of BSE in the United States, at least in part thanks to an FDA rule prohibiting the use of most mammalian tissues -- which are the apparent carrier of the disease -- in feed for cattle and other ruminants. We're continually strengthening our enforcement of this feed rule by inspecting thousands of renderers and feed mills.
<http://www.fda.gov/oc/speeches/2002/gma0609.html> as retrieved on 20 Apr 2005 13:12:42 GMT
- (23) As witnessed in the Acts of the Apostles and other ancient Christian writings, the faithful of the first centuries took Communion every Sunday, which then was called the Lord's day.
<http://www.orthodoxinfo.com/general/kingdomofheaven.aspx> as retrieved on 18 Apr 2005 16:04:51 GMT
- (24) And yes, this ISN'T the only depiction of dinosaurs and man co-existing. There were clay statues of Stegosaurus, Allosaurus, Brontosaurus Iguanadon, etc (I'll re-post them, they were on another post before, if you want). Nor is it the first time they were WRITTEN ABOUT. In Enoch (and related texts to Enoch) it talks about the Nehplilim (angel/human hybrid offspring) further hybridizing with 200 of every known animal which then became 'great monsters' which were up to 45ft in height and devoured the Earth, filling it with blood, eating other animals, HUMANS, and even each other. They ARE dinosaurs. The significance of this Brontosaurus (or Apatosaurus both names are valid) being depicted in PRE-DYNASTY times is that this is when this event of angels and human marrying creating hybrids was going on. I don't need anyone's approval on this, I have MOUNTAINS of evidence, I was just merely sharing this new found piece. Don't knock what you haven't even looked into. I HAVE.

<http://www.unexplained-mysteries.com/forum/lofiversion/index.php/t39957.html> as retrieved on 15 Jul 2005 22:15:25 GMT

- (25) To save time you can limit the comp size (always keep scale and rez the same: e.g. 1/2 size at 50%). When it plays back in the Comp Window the actual speed is noted in the Time Control window. To extend the length of preview with limited RAM you can Shift-0 to load every other frame which then plays back at a kind of cut rate real time. Ram preview can be used to check mouth actions with a sync audio track; Com+Opt scrub timeline for close analysis. Obviously it pays to have as much RAM devoted to AE as possible (if you are running OS9). If you aren't able to preview as much as you think you should, try purging all your RAM at Edit>Purge>All. AE knows what parts of the comp have been changed so subsequent previews render only the new material.

<http://www.geogrif.com/aetoons3.html> as retrieved on 27 Mar 2005 09:05:05 GMT

- (26) That resolution was rejected at the time by the Palestinians and every Arab regime, which then vowed to evict all Jews from the land, eradicating the embryonic nation. Now, after four wars and numerous terrorist acts, we are asked to believe that Israel's enemies have suddenly had a change of heart and that a diplomatic land grab is not a prelude to seizing the rest of the country.

<http://www.jewishworldreview.com/cols/thomas050799.asp> as retrieved on 26 Feb 2006 07:23:52 GMT

- (27) At Anderson Technologies, Don Anderson and his one machinist built the entire mechanical assembly from my fully detailed parts drawings. I had developed a fast method to make a detail drawing of every individual part which then got welded up into each sub-assembly. We didn't bother with formal final assembly drawings like most companies....the three of us knew where the stuff went. Don's twosome even added all the hydraulic system parts and hose plumbing, a major job in itself. I made the first drawing in March, and the fully tested mechanical assembly was delivered to the film studio in September....only three guys to do the whole deal! Sure felt sorry for how other companies worked.

<http://www.laughingplace.com/News-PID108470-108471.asp> as retrieved on 29 Mar 2005 14:38:07 GMT

- (28) "Throughput times were too long, as a form had to be filled out for every order, which then had to be passed through the various internal clearance points via inter-office mail.
<http://www.homeandoffice.hp.com/enterprise/downloads/eads.pdf> as retrieved on 17 Jun 2005 15:49:12 GMT

- (29) In some states, notably Utah and Colorado, "6" signs are missing from the segments of the highway that duplex with current interstate highways. In some state and local jurisdictions, Route 6 mileage markers are found every mile, and in many places the current 6 is given such names as "6 Hwy" (Ohio) or "Hwy 6 Trail" (Iowa). Most old segments, which have been bypassed either by a newer Route 6 or by placement of 6 on an interstate highway, are not marked in the western states. In the Midwest and East, however, they are most commonly given new names or numbers, sometimes as part of the policy of giving street numbers to every road in the county. Isn't it annoying to arrive at an intersection in the middle of nowhere, to find a sign: "224th Street West and 345th Avenue South"?

<http://www.augustana.edu/academics/geography/departments/route6/story.html> as retrieved on 13 Apr 2005 14:21:02 GMT

- (30) Unlike most other sciences which are based on experimentation, astronomy is a science of observation. The astronomer has to rely on the gathering of information. Light, of course, has always been his prime source of information and the necessity to explore its various properties soon became obvious. The astronomers started by mapping the sky which enabled them to distinguish the structure of galaxies. Later, by decomposing light coming from stars through a prism, spectroscopy was born. Thanks to this technique, astronomers were able to measure the surface temperature of stars.

<http://isdc.unige.ch/Outreach/Science/science.html> as retrieved on 20 Apr 2005 03:19:22 GMT.

- (31) The Prophet (PBUH) told us, "There are in the month of Ramadan in every day and night, those whom Allah (SWT) grants freedom from the Fire, and there is for every Muslim a supplication which he can make and it will be granted." (This supplication, which

is never rejected, occurs at the time of breaking the fast.)

<http://www.islammessage.com/bb/lofiversion/index.php/t2076.html> as retrieved on 17 Aug 2005 06:39:26 GMT

(32) Among those that were left disadvantaged from India and Brazil placing their specific interests in command were:

- the majority of developing countries which will find that their markets will continue to be flooded by dumped products from the US and EU. For the South as a whole, the opportunity to correct the distortions in agriculture trade legitimized in the Uruguay Round has been lost
- the African cotton-producing countries which failed to get negotiations on US cotton subsidies to be put on a fast-track independent of the agriculture negotiations, or even a commitment that all cotton subsidies will be eliminated;
- the Group of 33, which were left with nothing more than a vague commitment that their demand for ???Special Products‰ and the ???Special Safeguard Mechanism‰ and in particular, the coverage of products under such a mechanism, would be a subject of negotiations;
- most developing countries, which had rightfully opposed the text on market access of non-agricultural products as a prescription for their deindustrialization. Indeed, the US scored a big win on NAMA for the text is a detailed agenda for the radical liberalization that transnational corporations have long wanted. As the US National Association of Manufacturers saw it, ???This is a huge accomplishment, and a big win for the WTO, the United States, and the world economy. The really big accomplishment for industrial negotiations is that all countries have accepted the principle of big tariff cuts and sectoral tariff elimination.‰

most developing countries, which have now agreed to speed up their offers of services for liberalization. Dilemma

It was not that India and Brazil were not sensitive to the demands of other developing countries. In fact, they were given high marks for consulting the different developing country groupings. It was simply that by becoming central actors in the elaboration of the proposed framework, they had painted themselves into an impossible situation. And the more meeting interests began to diverge from a strategy of promoting the interests of the bulk of the developing countries, the more they trumpeted the claim that the July Framework Document was a victory for the South. It is testimony to the prestige of India and Brazil among other countries in the South that up till today, many developing countries do not realize how badly they lost in Geneva.

<http://www.southcentre.org/info/southbulletin/bulletin85/bulletin85-06.htm> as retrieved on 2 Jun 2005 07:55:48 GMT

(33) Programs composed of expressions. Lisp programs are trees of expressions, each of which returns a value. (In some Lisps expressions can return multiple values.) This is in contrast to Fortran and most succeeding languages, which distinguish between expressions and statements.

<http://www.paulgraham.com/diff.html> as retrieved on 18 Jun Apr 2005 18:39:39 GMT

(34) Layer 5 - Session - provides coordination between applications on each host.

Layer 6 Presentation - ensures communication between applications by translating data structures, formats and codes.

Layer 7 Application - provides the interface by which the user interacts with the network. *Note that layers 5-7 are somewhat unclear in most network designs, which concentrate on layers 1-4.*

OTDR Optical Time-Domain Reflectometer, used to find flaws in fiber optic cable.

Packet switch A device that moves packets from one network to another.

PhoneNet AppleTalk running on twisted pair copper wiring, using adapters.

<http://www.rochester.edu/its/ncs/documentation/glossary/glossary.html> as retrieved on 17 Jun 2005 18:34:20 GMT

(35) Doing this will cause iRider to download at least 2 or more pages simultaneously, if there are that many waiting to download, minimizing small delays in the download process.

Note that this doesn't eliminate all delays, such as those caused by slow websites and other factors.

On certain websites, downloading multiple pages at once can make iRider less

responsive — if you notice lagging response to mouse clicks or other actions, you may want to reduce the Minimum. (On current computers, lagging response is most noticeable on sites that use elaborate client-side scripts to build fancy menus or perform other tasks. When more than one page is running such a script, it can interfere with your use of any browser. Responsiveness issues can be acute on most other browsers, which download all pending pages simultaneously, and this is one reason iRider queues pages according to the Connection settings.)

iRider uses a lot of memory

iRider has sophisticated memory management features that will use available memory to speed access to open pages but release memory for use by other programs as needed when available memory drops too low. This distinguishes it from most other browsers, which rely on system virtual memory swapping if you open too many pages, resulting in very poor performance in all running programs. In iRider, you can open arbitrarily large sets of pages without difficulty.

<http://www.irider.com/support/faq.htm> as retrieved on 15 Jun 2005 08:41:31 GMT

- (36) Highlights from the Rome tasting stand out: a 1982 malvasia with flavors of apples, minerals and pears; a 1980 sémillon that tasted of hazelnuts and wax and seemed impossibly young. As the wines aged, the youthful acidity seemed to give way to mineral, earthy flavors. Yet unaccountably, in contrast to most white wines, which get darker with age, the golden colors of the young wines turned pale as they got older. How to explain this?

http://www.italianwinemerchant.com/IWM_Weekly_e-letter/IWM_03_17_05_Fiorano.htm as retrieved on 20 Apr 2005 03:26:01 GMT

- (37) As the patient was received their belongings were checked. Under the circumstances almost everything had to be taken from them for fear of contamination, and that which was saved was put through the decontaminator. Almost every man had a belt, which he did not want to let out of his possession. One man, after his belt had been thrown into the trash barrel, reached in and grabbed it. At his insistence the attendant ripped the belt open, and between the two thin layers of leather were three one hundred dollar bills in American currency neatly rolled into almost infinitesimal size. Small wonder he held onto his belt!

http://www.chgs.umn.edu/Histories__Narratives__Documen/Minnesotans_and_The_Holocaust/America_at_Dachau/America_at_Dachau_-_Hospitaliz/america_at_dachau_-_hospitaliz.html as retrieved on 20 Jun 2005 22:56:49 GMT.

- (38) Most of the time one has to keep one's head well down, but a combination of sinus and cardiac disabilities makes it necessary to stand up quite often, so there is plenty of time to look around at whatever's going on... time to observe how seagulls fly.. and time to carry away to the rubbish bin outside the front porch such detritus as the seasons yield. In the summer, weeds by the ton, in the autumn and spring dead leaves, and the occasional commentary on our urban society - the odd beer bottle among the marigolds, and once I found a used hypodermic... but mostly it's paper and wrappings and carbon paper .. and ice cream cones, unidentified pieces of styrofoam.. just an endless supply, as if every passerby carried a wastebasket which he dumped in the churchyard. Among the lot, I managed to drop a roll of negatives, and have never since found them. And once, while I sweated away in near-darkness, planting a rose bush, my spectacles dropped out into the vegetation. Finding them was a real miracle.

<http://www.montreal.anglican.org/parish/ndg/trinity/tt9802.htm> as retrieved on 28 Jun 2005 18:13:18 GMT

- (39) But there is one Law of the Medes and Persians which is sensibly relaxed these days. We, the newly joined, have always been given to understand that whatever else you do, you must never, never betray any interest in your profession--in short, talk shop--at Mess. But in our Mess no one ever talks anything else. At luncheon, we relate droll anecdotes concerning our infant platoons; at tea, we explain, to any one who will listen, exactly how we placed our sentry line in last night's operations; at dinner, we brag about our Company musketry returns, and quote untruthful extracts from our butt registers. At breakfast, every one has a newspaper, which he props before him and reads, generally aloud. We exchange observations upon the war news. We criticise von Kluck, and speak kindly of Joffre. We note, daily, that there is nothing to report on the Allies' right, and wonder

regularly how the Russians are really getting on in the Eastern theatre.

http://www.pagebypagebooks.com/Ian_Hay/The_First_Hundred_Thousand/Blank_Cartridges_The_Laws_Of_The_Medes_And_Persians_p5.html as retrieved on 4 Jul 2005 01:15:38 GMT.

(40) She said The Base consists of three elements:

- -An Element who had fixed his opinion, his candidate, and sticks to him.
- An Element who decided not to vote.
- And an Element who is wavering, and he is the one to whom all invitations and debates are addressed, to convince him to vote for one of the candidates.

She said every candidate has a message, which he keeps repeating to people's attention until they memorize it...

http://grannyinsanity.blogspot.com/2004_10_17_grannyinsanity_archive.html as retrieved on 14 Apr 2005 11:19:38 GMT.

(41) The school's 1,100 students, from kindergarten through 12th grade, are placed in simulated families. They live in one of 117 houses with several other students of different ages and a house-parent couple. Every kid has a bike, which he or she can pedal to the newly constructed Town Center, a grassy circular area modeled on "the world's timeless community gathering spaces, such as the town center of Siena, Italy, the Agora in Athens, and St. Peter's Square in Rome."

<http://slate.msn.com/id/2071150/> as retrieved on 5 Jul 2005 16:43:45 GMT.

(42) 'It was so clever of him to guess your secret so as to win your heart,' said she. 'And of course be told you his, in return?' 'No, I don't think he has got any,' returned Zoulvisia. 'Not got any secrets?' cried the old woman scornfully. 'That is nonsense! Every man has a secret, which he always tells to the woman he loves. And if he has not told it to you, it is that he does not love you!'

http://www.online-literature.com/andrew_lang/olive_fairy/20/ as retrieved on 28 Jun 2005 20:31:02 GMT.

(43) In the server I'd create personal folders and specify for every folder access rights: admin, certain user, all users, etc. I don't need quota management. Is this the way it should be configured? Or is it done this way: every user has a login which he uses to access whatever client computer he is using and he is automatically connected to the server and the server's drive is mapped locally? Which one is better? Which one requires the most management? Which one can be done in plain XP Pro and which one needs a server OS? Or am I completely lost and the network should be configured completely differently? Will I be able to do it or we'll need a VAR to set it up?

<http://forums.enterpriseitplanet.com/history/topic.php/1540-1.html> as retrieved on 30 Jun 2005 09:14:51 GMT

(44) There is one big drawback, though. Users won't be able to install Service Pack 2, unless they integrate SP2 in the installation CD. And that's probably too much trouble for most users, who of course are better off buying a legal version anyway. It is expected that Microsoft will change the setup files soon to prevent this hack.

http://www.theregister.co.uk/2005/06/03/xp_hack/ as retrieved on 7 Jul 2005 23:31:27 GMT.

(45) The audience for the debate largely sided with Suzuki. Not surprisingly, most Americans (who of course never read *Philosophy East and West*) tended to prefer Suzuki's timeless truths to Hu Shih's medieval past, his idealized Zen Japan to Hu Shih's remembered Chinese tradition. Given the longstanding American weakness for a timeless Orient (and the postwar shift in America's Pacific alliances), this may have been inevitable. In any case, Suzuki's style of Zen went on to boom in America, spreading from the beats in the '50s, hippies in the '60s and "self-realization" movements of the '70s to become the frequent feature of pop psychology and "new age" California culture and the earnest interlocutor in comparative philosophy and Buddhist-Christian dialogue that we see today.

http://www.stanford.edu/group/scbs/Resources/Papers/bielefeldt.zen_wars.html as retrieved on 4 Jul 2005 14:19:10 GMT

(46) How many prosecutors have been called down and disciplined for such unconscionable behavior? The answer is simple, damn few and far between! Why? Because the How about talking to Academy members about this? These folks are bright, visionary and creative. It appears that most Academy members, who certainly care about

intellectual property rights, profits they helped create, and their job future are shocked, appalled and very troubled by the hasty MPAA actions and they would prefer a suspension of this action and an opportunity to help find and execute the better solutions.
<http://www.filmthreat.com/News.asp?Id=1446> as retrieved on 27 Jan 2005 06:17:16 GMT

(47) Then there was the "backyard dog" law the supes passed last month, decreeing which types of water bowls "pet guardians" should use and the proper amount of kibble to feed Fido. While I'm sure the pooches are thrilled, last time I checked, they don't pay taxes. Neither do most homeless people with dogs, who of course are exempted from the law. Along with freedom to urinate on the street, the homeless are apparently free to mistreat their dogs. Supervisor Bevan Dufty sponsored the legislation at the request of the San Francisco Commission of Animal Control and Welfare, which argues that the law will make it easier prosecute cases of neglect. Though laws against animal cruelty are necessary, ones mandating tip-proof water bowls have perhaps taken it a step too far. To quote Alioto-Pier, who opposed the ordinance, it's just a little "too Big Brother"
<http://www.sfgate.com/cgi-bin/article.cgi?file=/gate/archive/2005/02/08/cstillwell.DTL> as retrieved on 8 Jul 2005 00:42:16 GMT.

(48) How many prosecutors have been called down and disciplined for such unconscionable behavior? The answer is simple, damn few and far between! Why? Because the so-called "Criminal Justice System" (excuse the oxymoron) is the largest, fastest growing industry in the United States. A large segment of the legal profession has a vested interest in this lucrative industry. Its my opinion that most attorneys who primarily practice criminal law, whether defense or prosecution, and most judges (who of course are in the same union) do not wish to rock the boat they are riding on for a variety of reasons, some excusable, some not. I view the legal profession as no different than any other profession when it comes to cleaning its own house. Attorney Canons, codes of ethics and prescribed guidelines for professional conduct mean absolutely nothing unless vigorously and swiftly enforced.

<http://www.m2solids.com/kensu/woody.html> as retrieved on 29 Jun 2005 11:05:51 GMT

(49) Voter turnout will be maximized by hands-on GOTV efforts. GOTV should be more than signing up voters leading up to the election, it should be about energizing voters NOW. What better way to maximize this than to have a consistent message passed to every county chair, who then passes it on to every District chair, who then passes it on to every block captain, who then discusses it with their friends and neighbors at the park, the pool, the coffee shop, the diner. This takes very little resources once a consistent message is decided upon and the chain starts. It just takes a little energy at the roots, and we know how much energy our roots have!

<http://www.ncdp.org/node/413> as retrieved on 13 Jun 2005 18:52:49 GMT

(50) It is God's life-changing power that is able to touch every individual, who then has the responsibility to touch the world around him with the absolutes found in the Bible. In the end we must realize that the spirit of the age - with all the loss of truth and beauty, and the loss of compassion and humanness that it has brought - is not merely a cultural ill. It is a spiritual ill that the Truth given us in the Bible and Christ alone can cure.

<http://razorskiss.net/wp/?p=106> as retrieved on 7 Jun 2005 04:01:26 GMT

(51) Dr. McCormack announced that it was time to identify two representatives from each Advanced Concentration to serve on the Recruiting Committee. This is a group that will discuss the recruiting procedures and make phone calls to some of the prospective applicants. Also, we need two representatives from each Advanced Concentration for the Admissions Committee. The Admissions Committee has a bigger workload; they preview every completed application, which then gets read by four Committee members. For the Admissions Committee, there are a couple of meetings in December and for January through April we'll meet every week (usually Thursday afternoon starting at 1:00 PM until whenever we finish). Dr. Baker suggested that the Chairs provide us with a list of people they would be willing to assign to this Committee and then we could contact them to ask them if they would be willing to serve. Dr. Sumners agreed it would be a good idea. Furthermore, Dr. Sumners pointed out that on our web page we have a list of mentors who have said they would be willing to have someone in their lab, and he suggested they should also be willing to serve on this Committee.

<http://idp.med.ufl.edu/ADVISORY/2000-0928.htm> as retrieved on 30 May 2005 23:04:31 GMT

- (52) They looked like the many Iraqis I had met over the years, but something had come out of them, some long subdued and oppressed core of selfhood that I was not, frankly, certain could be there. It was like the genie of the "Tales of 1,001 Nights" when he suddenly emerged from the lamp. Such smiles also emerged out of the long-oppressed Eastern Europeans after the fall of the Soviet Union; but they have not yet come out of most Russians, who of course lived the model of Stalinist domination that Saddam adopted for his country.

http://www.uexpress.com/georgieannegeyer/?uc_full_date=20050201 as retrieved on 8 Jun 2005 03:37:45 GMT

- (53) Enduring Grace presents the special contributions of women mystics. It gives a clear and realistic description of the women, their lives and the times in which they lived. In doing this, they come alive as real people who faced day to day difficulties, no different than the modern day reader. In regard to some of their more unusual behavior, Flinders encourages the reader to view the mystics with compassion and understanding. Flinders elucidates how very ordinary women transformed themselves into extraordinary individuals who made extraordinary contributions. She further illustrates how these women belong to us all and gives every female reader a legacy which she can claim as her own.

<http://www.amazon.com/exec/obidos/tg/detail/-/0060626453?v=glance&vi=customer-reviews> as retrieved on 28 Mar 2004 19:40:39 GMT

- (54) also read a story where this person (forgotten who) surrounded by his guards told his visitor - that had just threatened him in some way - that there was no way that he could kill him while he was surrounded by his most trusted guards, who of course never left his side. Upon which the visitor just told the guards to reveal their true identity...

http://allempires.com/forum/get_topic.asp?FID=14&TID=2128&DIR=N as retrieved on 22 Feb 2005 03:37:44 GMT

- (55) Question: What does the goddess Athena control? Answer: Every goddess has a realm which she controls. Some realms have physical boundaries, like an island or a spring. Some are more spiritual such as a process or quality. Athena is the Greek goddess of wisdom. She was also the goddess of industries and prudent intelligence in war. Athena is not the source of all wisdom, but she is certainly believed to be the source of some of it.

<http://www.fjkluth.com/athena1.html> as retrieved on 2 Jul 2005 14:32:26 GMT

- (56) *by Norton Rose*

Despite old adages about employees being a company's greatest asset, this is not reflected in most company accounts which measure employees in terms of a labour cost made up of elements such as pay, benefits and investment in training

<http://www.adecco.com/Channels/adecco/human+resources/the+law+at+work/human+capital.asp> as retrieved on 18 Jul 2005 16:14:29 GMT

- (57) For example, the author shows that industry information has become more valuable in terms of portfolio diversification benefits than country information, especially after the introduction of the euro, which contrasts with the literature of the 90s. Therefore, investors should change their view in the euro area to a sector-based approach. Most institutional investors, which are the biggest investors in the euro area, have already changed their view into a sector-based approach. As a consequence, euro area portfolio managers are nowadays tracking sector indices instead of country indices. One of the chapters in part II of the thesis shows the implications of that change for the banking sector. Stock returns of big banks have become more correlated, while this is not the case for smaller banks. The author argues that this is not a result of a similar performance or product portfolio of these banks, but is likely the result of the change in perspective of most euro area investors.

<https://dspace.ubib.eur.nl/handle/1765/6666?mode=full> as retrieved on 2 Jul 2005 15:17:11 GMT

- (58) The Kendall Howard Rack Mounted Centerline Vented Shelf is one of the strongest most stable shelves on the market. Unlike most centerline shelves, which may "teeter", our centerline shelf is rock solid. The mounting flanges are not only press welded onto each

side but wrap completely around the bottom to give it unprecedented stability and strength. This patent pending design will truly prove to be one of the strongest racking components you can own.

http://www.electronix.com/catalog/product_info.php/cPath/248_379/products_id/14034 as retrieved on 30 Apr 2005 19:53:16 GMT

- (59) **Sound Doctrine A Tactical Primer** Charles Sid Heal In recent years, law enforcement has suffered a number of tactical fiascos. Besides the loss of life and deterioration in public confidence, officers and agencies have been the subject of both civil and criminal sanctions. Unlike most tactical books, which teach tactics as a skill set this book emphasizes an intuitive application of fundamental principles. These principles have evolved over centuries of tactical operations and form a body of sound doctrine. Heal not only presents a distillation of the more than ninety tactical texts, but provides an insightful and compelling call for rethinking tactics of law enforcement. Assuming no prior experience or understanding of tactical matters, Heal draws from everyday life such as competitive games, driving, or planning a vacation to show how to reconceptualize a difficult situation. Because the fundamental concepts he explores apply to all types of emergencies, Sound Doctrine is suitable for not only law enforcement, but firefighters, private security and other emergency responders.

<http://www.lanternbooks.com/detail.html?id=1930051115> as retrieved on 2 May 2006 12:12:28 GMT

- (60) **NEAR Security Radar (Pilot)** This is the second version of the NEAR Security Radar which the EastWest Institute's NEAR (New European American Russian) Forum attempts to provide you with concise analysis which we believe you will find relevant and helpful in your work. The Radar is designed to provide a trilateral EU, US and Russian analysis of key developments in the matrix that combines the topics set as the main areas of focus for the NEAR Forum. This pilot issue focuses on the most important events, which have occurred in the South Ossetia during the week of 8-16 July 2004. The weekly issues of the Near Security Radar will offer an in-depth analysis of both past and upcoming events as seen and discerned from the NEAR Forum staff in Russia, the European Union (Brussels) and the United States. The issues will be mailed to you electronically and posted on our web site at <http://near.ewi.info>. We welcome your suggestions and comments.

<http://www.ewi.info/programs/news.cfm?title=Program%20News&l1=Programs&l2=Global%20Security&l3=> as retrieved on 3 May 2005 00:53:02 GMT.

- (61) **Are there exhibition opportunities for students?**

Yes. Unlike most art educations, which culminate in one group show of the graduating class, CalArts students have many exhibition opportunities throughout their time in residence. There are seven on-campus galleries at CalArts for the purpose of exhibition of student work. First and second-year BFAs typically participate in several group exhibitions per year, while 3rd and 4th year BFAs along with all MFAs have solo shows each year.

<http://www.calarts.edu/schools/art/faq.html> as retrieved on 30 Apr 2005 20:40:13 GMT

- (62) **Research is advancing on promising new means of treating drug addiction using immunotherapies and sustained-release (depot) medications.** The aim of this research is to develop medications that can block or significantly attenuate the psychoactive effects of such drugs as cocaine, nicotine, heroin, phencyclidine, and methamphetamine for weeks or months at a time. The promise of the new medications rests not only on their longer action, but also on differences in the way they operate. Unlike most existing treatments, which are active in the brain itself, immunotherapies act by binding the drug in the bloodstream and preventing it from reaching the brain. This represents a fundamentally new therapeutic approach that shows promise for treating drug addiction problems that were difficult to treat in the past. Despite their potential benefits, however, several characteristics of these new methods pose distinctive behavioral, ethical, legal, and social challenges that require careful scrutiny.

<http://darwin.nap.edu/books/0309091284/html/1.html> as retrieved on 30 Apr 2005 16:30:42 GMT

- (63) **Common Nonmetric Business Paper Sizes**

Width precedes height; Inch measurements are exact; Metric measurements are

approximate (calculated at 1 inch = 25.4 mm and rounded off); Standardized sizes are listed at left; Variants are listed at right; Most variant sizes, which are device dependent, are simply intended to accommodate registration marks.

<http://home.inter.net/eds/paper/dtpofficepaper.html> as retrieved on 1 May 2005 14:20:01 GMT

(64) April 17, 2005

Looking down at a deep draft

Unlike most NFL drafts, which feature a handful of can't-miss prospects on whom there is a consensus, this year's class remains an enigma. In this case, one man's blue-chipper is another man's bust.

<http://www.newsday.com/sports/columnists/ny-spglaub174222087apr17,0,3842639.column?coll=ny-sports-columnists> as retrieved on 15 Jul 2005 04:24:59 GMT

(65) The few minutes it takes to adjust the direction of the telescope's beam may not seem like much to an outside observer. Even for most scientific purposes, which focus on a few celestial objects for long periods of time, taking a few minutes to point the telescope is time well spent. For SETI@home, however, the time it takes to mechanically move the feeds from one point to another is simply time wasted. The shorter the amount of time spent on adjusting the telescope, the more time will be left for actual observations, and more candidates that will ultimately be revisited.

http://www.planetary.org/stellarcountdown/reobservations_1.html as retrieved on 30 Apr 2005 00:05:57 GMT

(66) 03/03/2005: Holcim report whets shareholder appetite The 2004 report of cement giant Holcim makes a refreshing change from most company reports, which focus on the financial ups and downs of the past year. In the introduction, Holcim explains to shareholders why it pounced twice in January to announce major planned acquisitions, one in Britain and the other in India.

<http://aggregateresearch.com/reports/> as retrieved on 15 Jul 2005 21:30:28 GMT

(67) There's been plenty of talk over the past week about "froth" in the real-estate market, much of it very general and a lot of it irrelevant to most local markets, which tend to more closely resemble middling Tampa or Phoenix than super-hot spots like San. Francisco or West Palm Beach. Consequently, all this bubble talk can't be taken too seriously -- what really matters are the regional fundamentals, which too few people pay attention to.

http://levelgaze.blogspot.com/2005_06_01_levelgaze_archive.html as retrieved on 3 Aug 2005 17:23:39 GMT.

(68) Do T cell responses to mutated self antigens reveal how immunity against cancer is generated? Not exactly. Tumors that are elicited by short, intense exposure of rodents to potent carcinogens carry large numbers of mutations, and these tumors arise over weeks or several months. These experimental models do not adequately reflect the pathogenesis of most human cancers, which result from multiple discrete mutations accumulated sequentially over decades

<http://www.pubmedcentral.gov/articlerender.fcgi?artid=503781> as retrieved on 28 Aug 2005 22:32:18 GMT

(69) "The inconclusive result does not mean we have found another case of BSE in this country," Clifford said. "Inconclusive results are a normal component of most screening tests, which are designed to be extremely sensitive so they will detect any sample that could possibly be positive."

<http://lists.ifas.ufl.edu/cgi-bin/wa.exe?A2=ind0406&L=sanet-mg&P=17085> as retrieved on 28 Aug 2005 23:54:48 GMT.

APPENDIX 2

Universals as Topics

- (1) What a disappointment King turned out to be. I so hoped her reverence for life would be genuine. Like the drifter in her song, she, too, "fell into someone's wicked spell." As for every one of her records, cassettes and CDs that once helped me walk the path, the garbage has become their final destination. The Natural Woman turned out to be a callous capitalist. Gone is the magic woven by her music. So are the blue and gold hues of her Tapestry; they now are tainted with the blood on Castro's hands.
<http://www.cubanet.org/CNews/y02/feb02/22e4.htm> as retrieved on 18 Jun 2005 19:49:40 GMT
- (2) As for every thing else he said some of it maybe true but due to the fact that we are fans of the show on this forum i think he should leave, as he clearly isn't nor wants to be and in fact has probably never watched it!
<http://168.215.229.9/thread.asp?b=2&t=7304> as retrieved on 22 Feb 2005 04:29:51 GMT
- (3) As for everyone who keeps imagining what they would have done, how they would have reacted, etc, the thing you are all forgetting is that you probably don't have the training and resources that the President of the United States has.
<http://archive.avsforum.com/avs-vb/history/topic/414151-1.html> as retrieved on 8 Aug 2005 08:43:27 GMT.
- (4) I'd like to thank Aldermen Harris, Johnson, Bates, Sansone and Mayor Titter for their support on killing this issue. What impressed me most, however, was the commitment made by Alderman Lloyd Harris of Ward 3. Not only did Mr. Harris vote no on this issue, he went out and polled the citizens prior to the meeting. Mr. Harris made contact with Pacific residents in all three wards. He stood out in front of stores, the post office and other locations around the city. Each person who he contacted, he asked their opinion on this issue. Not once did Mr. Harris find a resident who was in favor for an appointed chief of police. This gave me hope for the residents of Ward 3 because Alderman Harris does care for your opinion.
http://www.zwire.com/site/news.cfm?newsid=15169584&BRD=1409&PAG=461&dept_id=544418&rfi=6 as retrieved on 15 Jun 2005
- (5) "He's well-grounded," Willis said. "Irregardless of him playing in the NFL, he's going to be special -- and special in a leadership role. Every person who crosses his path, he affects them in a positive way."
http://sports.espn.go.com/espn/columns/story?columnist=forde_pat&id=2163271 as retrieved on 17 Jun 2005 11:49:58 GMT

APPENDIX 3

Cataphora

- (1) Editorial Reviews —Product Description: It doesn't matter if she's 5 or 105, every female LOVES these rich, thick feather boas. These are professional weight, not skimpy and they are over five feet long! They can be silly or sexy or glamorous or just plain fun. Solid peach.
http://www.featherfinding.info/boo_feather-collectibles.html as retrieved on 26 Aug 2005 08:08:47 GMT.
- (2) While my situation is not as long and as tumultuous as yours, I have found ways to keep my GD in my life. At first it was the same as you...backing off. OBD would threaten to keep GD from me. I would fight with her and the vicious cycle would continue. Then I started saying, "it's your choice of course, but you would only hurt GD if you kept her from me." Now, OBD needs me waaaay too much...I'm free daycare. Which is what I was thinking you could offer Jessica. Free daycare. Even if she is not working, every mother needs a break from her kids. With my daughter, sad as it is for me to admit, mostly she will cooperate if she is getting something out of it, or if it takes some responsibility off her shoulders. Perhaps you can appeal to that side of Jessica. You present it as how you are helping her, she doesn't have to know your true goal.
<http://www.steptogether.org/forum/showthreaded.php?Cat=&Number=395301&page=&view=&sb=5&o=&vc=1> as retrieved on 1 Mar 2005 21:58:25 GMT.
- (3) As for the birth mother, understand that she was told, at some point, that she wasn't needed any more and if she really loved her child she would gracefully disappear. Even if she surrendered her child of her own free will, every birth mother is left with a sense of emptiness and loss -- if not regret and resentment -- for it's impossible to "forget and go on as if it never happened." Isolated in secrecy, birth mothers have no way of knowing the emptiness they feel is "normal". So, thinking they have failed yet again, they hold this shame close to their heart in the same dark place where they hide their primal grief over the loss of their child.
<http://www.vhl.org/newsletter/vhl1995/95dcadop.htm> as retrieved on 4 Aug 2005 16:24:38 GMT.
- (4) "Then came a band of fifty Sikhs-and a heroic scene. The Sikhs, as you know, are a fierce fighting brotherhood. As soon as he can raise one, every man wears a beard which he curls around a cord or ties to his ears. The Sikhs also wear their hair long like women and curl it in a topknot under their turbans. These Sikhs were Akalis of a fanatic religious sect. They wore the kirpan, or sacred sword.
 "With them were fifteen of their young girls and women. The women also wore sacred swords, and although dressed in orange saris like Hindu women, they wore little cotton trousers which reached to their tiny, sandaled feet. They were pretty girls and not so loud voiced and excited as the Hindu ladies. They simply smiled-as if they liked danger-which they do.
<http://www.jesusradicals.com/library/gregg/examplesofnonviolence.html> as retrieved on 19 Jun 2005 17:34:51 GMT

APPENDIX 4

Quantificational Subordination

- (1) At the turn of the century, there was no question about it --marriage was thought to be the ideal state for every woman, and she pretty much spent most of her young life preparing for it. However, there were definite etiquette rules that she..
<http://www.lahontanvalleynews.com/apps/pbcsad.dll/adlink?Spot=spotlight,Sports&Req=70046880106276463> as retrieved on 26 Sep 2004 07:46:21 GMT.
- (2) Written Evaluations: It is important that each client attend every session. If he/she misses a session, Iris Counseling Center will notify the Court for appropriate action. After the 12 session program, group leaders provide a written evaluation which addresses:...
<http://hadm.sph.sc.edu/students/kBelew/iris.htm> as retrieved on 22 Mar 2005 12:18:55 GMT.
- (3) Every man, and he need not be always a professional sportsman, longs for being the best at something sometimes.
<http://www.mylanex.com/en/o-nas/novinky/pribehy.php> as retrieved on 18 Jun 2005 18:30:45 GMT
- (4) Personality: He gives away nothing with his eyes or his body language; he looks almost completely robotic except sometimes his look will just border on dislike, amusement or curiosity. He is a very hard one to get a handle on. He will not speak unless directly addressed in such a way that requires an audible answer. He is beyond graceful in everything that he does, looking as if every move is precisely planned, but it's not. Inwardly he finds his whole situation ironic, as he had once been the master of a large house with many servants and slaves. Often mentally comparing his current situation with one from his own past, this is where the amusement comes from.
http://www.ravenswing.com/~keys/independent/dark_angel_desc.html as retrieved on 27 Jul 2005 21:46:37 GMT
- (5) As long as I am not able to vote at the Lebanese Elections at my Lebanese Consulate I would feel that I am not been giving my full constitutional rights. No excuses, no equivocations, while my French, American, Syrian friends may vote at their local consulate, I feel that I am unfairly treated. The same request extends to every regularised Lebanese who works legally overseas and who happens to be overseas during the Elections; he should be able to exercise his constitutional right to vote, and he should be able to do it at his nearest consulate or embassy. All those vehement talks, reasonings, excuses, shoutings against my requests do not hold water. Voting is a constitutional right of every Lebanese, and he should be able to exercise it when he is overseas. Let us see your reaction to that!
 Chawki Nassar (by LibanVote)
http://www.libanvote.com/cgi-bin/dcforum/dcboard.cgi?az=read_count&om=23&forum=DCForumID79 as retrieved on 27 Jan 2005 13:41:56 GMT.
- (6) Each garden has a gardener who maintains it. He / she takes care that it grows und stays in order. He / she is responsible for the discussion under the .main tree.. In addition, he / she makes sure that the ripe fruits are harvested and processed into marmalade (i.e. the experiences recorded and processed). The one planting an own palaver-tree is the person who moderates the discussion and carries out the safeguarding and processing of the experience in its shadow.
<http://unpan1.un.org/intradoc/groups/public/documents/NISPAcee/UNPAN015612.pdf>. as retrieved on 20 Jun 2005 15:33:55 GMT.
- (7) A good theory simply weaves together observations into ordered patterns that predict events. If you can't readily infer from a theory the observations and the accuracy of the observations that it is built upon, then that theory is asking you to make a leap of faith that is probably unwarranted. Thus, to claim that people have a need for achievement or have an oedipal complex implies a basis in facts that aren't readily apparent, and a type of neural or mental mechanics that is as obscure as any of Ptolemy's planetary loop the

loops. So one must avoid postulating little mentalisms like drives, needs, egos, and the like, and simply note the patterns in which people, like the stars in heaven, move. Theories should mirror the facts or our own experience, and should be judged on the basis of how they make that experience comprehensible and predictable. Every man can know himself, he only has to observe himself. Effective thinking thus should be the province of every man, and he should never meekly surrender it to any 'expert'.

<http://www.homestead.com/flowstate/files/zselfhelp.html> as retrieved on 21 May 2005 02:52:15 GMT.

- (8) In Fits it's all about speed. Every player gets a board which he needs to fill with colored tiles (Small and large triangles and squares in 4 colors). The dice defines which tile to pick from the tile holder and the player needs to place this piece on his/ her board. But the piece can't touch other pieces of the same color. The fun part is that the dice can't lay still for more than five seconds. So after one minute you have lots of pieces on and besides your board and are pretty stressed to make it all fit on the board. The first player who can make it all fit on his board, wins.
<http://www.boardgamegeek.com/game/10565> as retrieved on 26 Jun 2005 23:37:59 GMT
- (9) The idea of universal brotherhood is one for universal application, however. The challenge comes to every man, and he meets it where it affronts his sense of justice. For some, this is on the question of religious prejudice, for others, racial, etc. For theosophists, the fight must be against all prejudice -- against the materialism and ignorance that are the causal synonyms of prejudice. The theosophical philosophy, perhaps, rather than any individual, leads the fight for tolerance, because Theosophy has the whole of Humanity for its object. All those who work to abolish any particular prejudice are allies of the Theosophical Movement to the extent that they dedicate their efforts to some portion of their fellow-men.
<http://www.wisdomworld.org/additional/Youth-CompanionsAsk-/QandA-No.3-Dec.1947.html> as retrieved on 23 Jan 2005 08:20:12 GMT
- (10) Marriage is the great dream of every woman and she feels it is a dream that can absolutely change her life. As society is changing towards becoming a hi-tech society, marriage is becoming a terrible dream for many women.
<http://www.tribuneindia.com/2002/20020203/herworld.htm> as retrieved on 6 Feb 2005 00:15:21 GMT.
- (11) They Grow 'em Tough on the Llano!, (nv) Star Western Aug 1943; Banks Presnall paid all too careful heed to the admonition: 'There's times when every man meets something he can't get around. Then he needs a gun to blast himself through!'.
<http://users.ev1.net/~homeville/fictionmag/s571.htm> as retrieved on 30 Aug 2005 00:52:27 GMT
- (12) Liberty is given to every individual. If he wants to turn himself towards a good path and be righteous, the power is in his hands; and if he wants to turn himself towards the path of evil, the power is in his hands.... Man is unique in the world and there is no other creature similar to him in this regard: that he on his own, with his knowledge and thoughts, will know good and evil and do whatever he wants, and there is nobody who will prevent him from doing good or evil.
Maimonides, Mishna Torah, Laws of Repentance 5:1
http://www.aish.com/shmooze/equal_measures_of_free_will.asp as retrieved on 2 Jul 2005 12:28:41 GMT.
- (13) After all, every murderer when he kills runs the risk of the most dreadful of deaths, whereas those who kill him risk nothing except promotion.
http://www.spicyquotes.com/html/Albert_Camus_Murder.html as retrieved on 4 Jul 2005 04:43:44 GMT.
- (14) Men in a State of Nature are absolutely free and independent of one another as to sovereign Jurisdiction, but when they enter into a Society, and by their own consent become Members of it, they must submit to the Laws. of the Society according to which they agree to be governed; for it is evident, by the very Act of Association, that each Member subjects himself to the Authority of that Body in whom, by common Consent, the legislative Power of the State is placed: But though they must submit to the Laws, so long as they remain Members of the Society, yet they retain so much of their natural Freedom as to have a Right to retire from the Society, to renounce the Benefits of it, to enter into

another Society, and to settle in another Country; for their Engagements to the Society, and their Submission to the public Authority of the State, do not oblige them to continue in it longer than they find it will conduce to their Happiness, which they have a natural Right to promote. This natural Right remains with every Man, and he cannot justly be deprived of it by any civil Authority. Every Person therefore who is denied his Share in the Legislature of the State to which he had an original Right, and every person who from his particular Circumstances is excluded from this great Privilege, and refuses to exercise his natural Right of quitting the Country, but remains in it, and continues to exercise the Rights of a Citizen in all other Respects, must be subject to the Laws which by these Acts he implicitly, or to use your own Phrase, virtually consents to: For Men may subject themselves to Laws, by consenting to them implicitly; that is, by conforming to them, by adhering to the Society, and accepting the Benefits of its Constitution

<http://www.historicaldocuments.com/InquiryintotheRightsBC.htm> as retrieved on 18 Apr 2005 15:05:29 GMT.

- (15) "Talk to every woman as if you loved her, and to every man as if he bored you, and at the end of your first season you will have the reputation of possessing the most perfect social tact"

http://en.thinkexist.com/quotation/talk_to_every_woman_as_if_you_loved_her-and_to/165784.html as retrieved on 19 Jun 2005 20:49:45 GMT.

- (16) But a greater awakening has come since April, 1917. It has taken the ploughshare of fire to reveal our true selves: this war is running the furrows deep in the hearts of men and turning up desires of which they were unconscious themselves in their days of ease. Men are flocking to Washington at the sacrifice of business and personal interests willing to pour out their all for the great stake of democracy; the moment came when the possession of self-government was imperiled and all leapt forward ready to lay down their lives to preserve it. This war has revealed the deeper self with its deeper wishes to every man and he sees that he prizes beyond life the power to govern himself. Now is the moment to use all this rush of patriotism and devotion and love of liberty and willingness to serve, and not let it sink back again into its hidden and subterranean depths. Let us develop the kind of institutions which will call forth and utilize these powers and energies for peace as for war, for the works of peace are glorious if men can but see the goal. Let us make a fitting abiding place for men's innate grandeur. Let us build high the walls of democracy and enlarge its courts for our daily dwelling.

http://sunsite.utk.edu/FINS/Mary_Parker_Follett/XXXIV.txt as retrieved on 20 Apr 2005 02:25:25 GMT

- (17) In the server I'd create personal folders and specify for every folder access rights: admin, certain user, all users, etc. I don't need quota management. Is this the way it should be configured? Or is it done this way: every user has a login which he uses to access whatever client computer he is using and he is automatically connected to the server and the server's drive is mapped locally? Which one is better? Which one requires the most management? Which one can be done in plain XP Pro and which one needs a server OS? Or am I completely lost and the network should be configured completely differently? Will I be able to do it or we'll need a VAR to set it up?

<http://forums.enterpriseitplanet.com/history/topic.php/1540-1.html> as retrieved on 30 Jun 2005 09:14:51 GMT

- (18) 40. All men on the program (which includes the halfway house) are subject to drug testing at anytime. The belongings of every man, and he himself, are subject to being searched at anytime. Refusing a test or a search automatically means that the man will exit the program. If a man is found to be using alcohol or any other mood-altering drug, he will, in every case, have to exit the program for at least 30 days. This exit includes being barred

<http://www.nashvillerescuemission.org/Handbook.pdf> as retrieved on 27 Jun 2005 18:20:14 GMT

- (19) Two things emerge here. There is a door of missionary opportunity before every man and he need not go overseas to find it. Within the home, within the circle in which we move, within the community in which we reside, there are those to be won for Christ. To use that door of opportunity is at once our privilege and our responsibility. In the way of Christ the reward of work well done is more work to do. Philadelphia had proved faithful

and the reward for her fidelity was still more work to do for Christ.

<http://www.apostle.org/lectures/rev3phi.htm> as retrieved on 26 Jun 2005 09:22:18 GMT.

- (20) KC: When did you develop an interest in graphic design and architecture? Have you always loved the visual arts or was it a later development?

ALW: Probably at school. I always used to draw from when I was very young.

Architecture came much later and I still have a battle with it as it focuses a lot of the frustrations I feel in the public and political arena and how people have been disempowered over their own domain. Northern man has allowed himself to become trapped into the requirements of a commercially driven building industry and the people who finance the purchase of houses. Building is something natural and instinctive to every man and he's lost that bit of his world and the high art that it produces. Most architects are stuck on vanity, reputation and commercial gain in my experience. Look how differently people build down in the desert and deeper into Africa.

<http://www.renderingislam.com/alwhiteman.htm> as retrieved on 1 Feb 2005 00:48:20 GMT.

- (21) Second as regards politics. Politics means the discussion and determination of matters of public policy. Shall the Government maintain a large army or a small one? Shall it charge Custom Duties on goods imported from abroad? How shall it impose and collect its taxes? Each question of this kind is a matter of national policy, and therefore of politics. Consequently matters of politics are of the utmost importance and the concern of all citizens. Every citizen, if he is a good citizen, will bring to bear on such questions his best judgment and will do whatever his duty demands toward putting into effect such policies as are determined upon.

<http://freemasonry.bcy.ca/texts/politics.html> as retrieved on 9 Jul 2005 07:42:01 GMT

- (22) "Every individual intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his original intention. By pursuing his own interest he frequently promotes that of society more effectively than when he really intends to promote it." - Adam Smith, (1776)

Wealth Of Nations (New York: Modern Library, 1937), p. 423. During the prosperous years of the 1920's, it was said that "every man could have his castle and he could have it in any style he wanted." Floral Park, with its rich cornucopia of architectural styles, is particularly representative of that trend.

http://www.floral-park.com/index_files/page0001.htm as retrieved on 16 Aug 2005 23:18:05 GMT

- (23) Every man has his own courage, and is betrayed because he seeks in himself the courage of other persons. Ralph Waldo Emerson

<http://www.brainyquote.com/quotes/quotes/r/ralphwaldo104714.html> as retrieved on 26 Jun 2005 16:42:26 GMT.

- (24) "What should I do to be happy, to fulfill myself?" Every man has his own intimate answer to this question, even when he does not formulate it explicitly. This answer works like a watershed: an inch to the left or to the right ends up taking the raindrop to Atlantic or Pacific Ocean, to final and definite fulfillment or failure. There are only two possible answers, as Augustine of Hippo has already pointed out in *City of God*: a man seeks either his own advantages trying to safeguard his life or those of God (and, through God, those of the remainder of mankind) burning cheerfully his life up to its complete annihilation.

<http://www.hottopos.com/videtur13/hae.htm> as retrieved on 1 Jun 2005 11:41:28 GMT

- (25) Every man has his particular work to perform, but unless it be on some large ranch where the force of men employed is sufficiently large to require the services of a chef, he is also expected to assist in keeping house. It is an unwritten law of the ranch that everybody on the place must share in this work and if anyone shirks his duty he must either promptly mend his ways or else quit his job. It is seldom, however, that this rule has to be enforced, as the necessities of the case require that every man shall be able to prepare a meal as he is liable to be left alone for days or weeks at a time when he must either cook or starve.

<http://www.worldwideschool.org/library/books/geo/geography/ArizonaSketches/chap4.htm> as retrieved on 14 May 2005 13:10:49 GMT.

- (26) We need to become acquainted with our frailties and deficiencies, that we may know where our weakness lies; otherwise, like Sampson, we are likely to expose ourselves to numerous temptations and troubles. Every man has his weak side, and every wise man knows where it is, and will be sure to keep a double guard there. Yet our limitations and incapacities can only be discovered by a considerable degree of self-acquaintance. How often have we attempted things beyond our reach and assayed to do things out of our powers; we were blind to our deficiencies through self ignorance. It has been truly said, "A wise man as well as a fool has his foibles: but the difference between them is, that the foibles of the former are known to himself and concealed from the world, while the foibles of the other are known to the world and concealed from himself."
http://philologos.org/pink/1934/self_knowledge.htm as retrieved on 21 Jun 2005 12:32:51 GMT
- (27) The castle was scratch built by Cheryl Oudshoorn. The game is a 6 player affair with 2 German (the Guards) and 4 allied players (Polish, French, Dutch and British) For the Allies it is every player for his country and he must get 2 POWs out before any of fellow prisoners do, the Germans goal is to prevent any one player from getting 2 men out.
<http://www.fortunecity.com/underworld/lylat/11/colditz3d.html> as retrieved on 19 Aug 2005 12:30:19 GMT.
- (28) Why is this interesting for the mailman list? Starship uses qmail. With qmail, every user has his own mailboxes, and he can handle everything like myname-other at site from his myname home directory. This is great. For Mailman, it is very bad, since it gives you headaches whenever you want to set up a mailman list named zope-users, when a user zope is also existent.
<http://mail.python.org/pipermail/mailman-users/1999-February/000598.html> as retrieved on 22 Aug 2005 09:13:03 GMT
- (29) Since I would not work on Sunday, we started on Monday, laying the job out with three men. On the day we started the actual building, it started to rain, which it did every day up to mid-morning. I hired every man who applied if he knew which end of a hammer to hold. On hiring them, I told them not to start unless they would work in the rain. We would stop only in the hardest downpours. I used up to 20 men; and Trent, Lindsey, and I had on raincoats and rubbers every day. When we drove the last nails at near noon Saturday, there were several hundred people already on the seats. When we figured up, we found it cost less than \$1 per person's seat, including my 19 percent profit. That was a pretty good investment for UT, as every seat was sold for \$2.50. The bleacher was used for seven years, though it was not always as full as it was that first time.
<http://freepages.genealogy.rootsweb.com/~caroltapp/rsdysart.html> as retrieved on 15 Sep 2005 11:40:41 GMT.
- (30) The idea of prices to guide dispatch decisions was introduced to the electricity sector in 1982 by Schweppes. Prices offer a unifying framework for communication, aggregating information in complex systems, and keeping the overall system efficient whilst allowing for decentralisation of individual decisions. In the energy market prices can be introduced as shadow prices to guide decisions, as audited prices to pay generators based on calculated costs or as market prices. In a perfectly competitive market assuming an infinite amount of buyers and sellers market prices equal variable costs of the most expensive generator required to match demand. If few electricity generators have major market shares then they can execute market power and push prices above competitive levels. Transmission constraints and short-term price inelastic demand increase market power.
<http://www.nautilus.org/DPRKBriefingBook/energy/neuhoff.pdf> as retrieved on 15 Sep 2005 11:40:41 GMT
- (31) Every journalist has a novel in him, which is an excellent place for it.
<http://www.brainyquote.com/quotes/quotes/r/russelllyn100848.html> as retrieved on 25 Jun 2005 15:42:56 GMT
- (32) One difference I noted was that, in this war, the American soldier is a technological wonder. Nearly every soldier owns a laptop, which he or she uses to play games or exchange e-mails from home.
http://www.staugustine.com/stories/022104/opi_2142736.shtml as retrieved on 7 Jul 2005 06:31:48 GMT (repeated from App. 1)

(33) 7. Try Guerrillas Tactics From China to Cuba to Vietnam history teaches the power of a guerrilla movement. Weak forces can flourish if they take up a guerrilla stronghold and resist being drawn into the open. Guerrillas are not organized like regular soldiers. The U.S. went into Vietnam with thousands of cooks, bakers, clerks, chauffeurs, chaplains and public relations officers. The smaller force of guerrillas had none of these, but virtually every soldier had a gun, which he used. A lean guerrilla organization can make quick decisions, seize opportunities and fill voids. A guerrilla force does not have the resources to waste on a lost cause. It does not hesitate to give up a position and move elsewhere—a flexibility envied by more entrenched forces (Reis and Trout, 1986).

Selected References Bevin, Alexander. *How Great Generals Win*. New York: Norton, 1993. Clausewitz, Carl von. *On War*. Edited with an introduction by Anatol Rapoport. 5. Manage Momentum

<http://www.cfar.com/cf/index.cfm?fuseaction=Publications.PublicationTracking&intPublicationID=75>. as retrieved on 9 July 2005: 17:56 GMT (repeated from App. 1)

APPENDIX 5

Quantifiers Embedded in *if/when* Clauses with anaphoric links in the consequent

- (1) 3) The question of relevancy is important too. Transportation statistics do not typically govern the behavior of the average person, but perceptions do. Perceptions dictate where people buy homes. They dictate property values. They determine if parents will let their children walk to the park or to school. They determine if folks socialize along the street. Perceptions affect behavior such as littering and property maintenance, how safe people feel, where they want to shop, and where they want to spend time. Perceptions are important. When perceptions are shared by many people, they can have huge effects. If most people perceive the downtown as dangerous, then they will not spend time there, invest there, nor live there. Consequently, the downtown will suffer. The same situation exists for neighborhoods and districts. Traffic calming can and does affect perceptions. Therefore, in cities where perceptions are an issue, there is nothing wrong with correcting them with the help of traffic calming
http://gulliver.trb.org/publications/circulars/ec019/Ec019_i5.pdf as retrieved on 9 Sep 2005 18:52:04 GMT.
- (2) For me, these two quotes show that this is a complex issue. If most people would simply 'eat right' then they'd get nearly all of the benefits. Weight and nutrition are two of a wide range of factors than an athlete must address to be competitive. There are a few examples of athletes with crap nutrition that are able to compete well. However, I believe, the poor nutritional decisions get us in the long run. Of course... as many will point out, we're all dead in the long run.
<http://www.byrn.org/gtips/bodycomp.htm> as retrieved on 15 Jul 2005 13:44:46 GMT.
- (3) If most of the looters are black, then they are black, and nobody can deny that.
<http://cubed3.clifton-hosting.co.uk/viewtopic.php?id=254&p=1> as retrieved on 9 Sep 2005 18:52:04 GMT.
- (4) Being perfectly imperfect means recognizing that your control over outcomes has limits. If every outcome were controllable, and if every mistake preventable, then it wouldn't be a risk - it would be a certainty. Risk taking involves chance and approximation. But more than that, it involves an encounter with your fallibility. Though your risks may indeed turn out perfectly, you as a risk taker will always have imperfections.
http://www.cec.globalsources.com/ART_PRNT_8800037227.HTM as retrieved on 7 Jun 2005 22:42:25 GMT.
- (5) Well, and they fail to forget the number of over/undervotes that were thrown out in predominantly Republican counties. So, if every vote counts, then it has to count in ALL counties- over and under votes. They will never get over it.
<http://freerepublic.com/focus/news/659575/posts> as retrieved on 30 Oct 2004 12:30:25 GMT.
- (6) The good news, though, is that none of the stuff I didn't like was Bill's fault. Remember: The screenwriter is the person least accountable for how bad a movie is, what with all the other people who muck with it before it hits your eyeballs. (Funny -- if every director thinks he can do better than the writer, why doesn't he just do the writing himself instead of hiring a writer to give him a script to "improve upon"?)
<http://www.coldfusionvideo.com/v/victimofdesire.html> as retrieved on 29 Apr 2005 11:21:30 GMT.
- (7) Journalists used the presence of the expert who is deeply involved in the issue to ask about sealed indictments which both politicians and lawyers are objecting so much about. Residovic said this unpopular form of indictments (legal practice insists on public character of indictments to prevent potential abuse) was used because it was dictated by reality. 'If every indictee knew he was indicted, he would have time to hide or destroy evidence. The surprise factor would be prevented,' said Residovic.
<http://www.medienhilfe.ch/News/2002/BiH/MOL0712.htm> as retrieved on 3 Jun 2005 10:41:38 GMT.

- (8) Warren has this theory that if he faces every shot like it's a corner then he'll save it no problem . . .
http://www.winnipegssoccer.com/colo03/cc_pictures6.html as retrieved on 1 Apr 2004 18:24:05 GMT.
- (9) You telling me that isn't happening now? Doing it McMillan's way, we would see better basketball, because if every player knew he would be going on the block at the end of every season, he would hustle his tail off and make it to every practice, or else when it came time for the annual free agent shuffle, there wouldn't be a lot of interest in his services. No more long-term contracts - which always wind up being renegotiated to the player's benefit anyhow.
<http://www.coachwyatt.com/FEB01.html> as retrieved on 5 Jun 2005 20:46:50 GMT.
- (10) When we gather as a vital faith community, we support and encourage each other. We "bear one another's burdens, and so fulfil the law of Christ" (Galatians 6:2). . If each stands alone then he or she is weak, but together we are strong! This is God's will for the Church, as stated in Hebrews: *"Let us consider how to stir up one another to love and good works, not neglecting to meet together, as is the habit of some, but encouraging one another, and all the more as you see the Day drawing near"* (Hebrews 10:24-25).
<http://home.nyc.rr.com/mysticalrose/religion4.html> as retrieved on 13 Jun 2005 18:47:59 GMT.
- (11) The second challenge is invariably what I call the "gross-out" test. It either involves laying in a pit filled with insects or animals (e.g., snakes, rats, and mealworms) or the contestants are challenged to eat something that is, for most of our palates, incredibly disgusting (e.g., sheep eyeballs and bull's testicles). A random order is selected for the six poor fools to attempt the challenge. If each succeeds, then he or she moves on to the next round. If one fails, that's the end of the game for him or her. The final challenge usually requires the contestants to do something better than the others. Therefore, just completing that challenge is not enough to win. Instead, you need to complete the challenge better than everyone else.
<http://www.popmatters.com/tv/reviews/f/fear-factor.shtml> as retrieved on 11 Jun 2005 09:15:24 GMT.
- (12) Okay, the taking a test to vote part isn't bad. That test being money is absolutely the worst possible thing that it could be. "Money is the root of all evil." Everyone's heard the phrase; it can't really be applied to anything concrete. But I can tell you that basing a country and its election processes on money would be the very worst thing for that election system. If you want to make a test for voter eligibility, here's a suggestion: when every American votes, he takes a sort of quiz on current events and such to decide if he is politically aware enough to participate in the election. Obviously the questions would not be incredibly difficult, but just enough to see if the citizens are paying attention enough to make reasonable votes. If a person fails the test, he doesn't vote - get involved and come back next year! The point? Get rid of those that don't vote based on anything worth basing a vote on, and encourage our citizens to really be aware of what they are voting for.
<http://crash.neotope.com/200108.htm> as retrieved on 29 May 2005 23:28:22 GMT
- (13) Eventually when every krongpa resigns, he or she would have served for six consecutive years. It is the most challenging and onerous task a person shoulders for his or her threypa. It must be noted that krongpa and pampa of all threypa are not appointed in the same year.
www.bhutanstudies.org.bt/publications/monograph/mng11-wayowayo.pdf as retrieved on 22 Jun 2004 13:22:34 GMT
- (14) Suppose everybody in the world loves universally, loving others as one's self. Will there yet be any unfilial individual? When every one regards his father, elder brother, and emperor as himself, whereto can he direct any unfilial feeling?
http://www.cic.sfu.ca/nacc/articles/legalmohist/mozi_mei/wadegiles/momei_14wg1.html as retrieved on 13 Dec 2004 08:18:16 GMT
- (15) Adams insists the media's depiction of him as an out-of-control alcoholic is an ugly, lazy stereotype that's easily marginalized by his vast artistic output. "I don't think that functioning alcoholics make two albums a year, plus B-sides and tour 200 days out of the year," he said. "My liver is not made of iron, as much as I wish it was sometimes."

Nobody's is. Once people get an idea of who you are, you become this cartoon character. I think if most rock people did everything people said, then they wouldn't be here. I'm not one of them. I'm a bad germ, but I don't have a death wish."

http://www.cmt.com/artists/news/1480350/11112003/adams_ryan.jhtml as retrieved on 20 Apr 2005 10:38:06 GMT.

- (16) If every man's house is his castle, then his garden must be his retreat!
http://www.publicservantlifestyle.co.uk/dynamic/sections/home_garden/article_display.php?id=2031 as retrieved on 2 Mar 2005 15:58:58 GMT.
- (17) After America's missions to the Moon, newspapers wrote that the Apollo program allegedly started bringing profit owing to the use of space technologies in conventional "earth" industries. The USA spent 24 billion dollars on the program: even if every spaceship were made of diamonds, it would be cheaper in comparison with its virtual price. Earth technologies comprised a meager part of the program's cost. It just so happens that it returns no profit, but only losses. Piloted space flights are a Russian kind of business that American scientists adhered to as a result of the pointless space race, a purely political propaganda race.
<http://all.newsfromrussia.com/society/2003/04/04/45590.html> as retrieved on 27 Feb 2004 17:33:11 GMT
- (18) Let's put today's text under the banner of motherhood. Every text in the Bible is a Mother's Day text if you believe that all Scripture is profitable for teaching and reproof and correction and training in righteousness, and if you believe that mothers need all that for the sake of their weighty calling. And if every text is relevant for motherhood, it is also relevant for fatherhood and singleness, and marriage without children, and widows and widowers. All Scripture is profitable for all people in all roles when the texts are rightly understood and applied.
<http://www.soundofgrace.com/piper2/piper2003/5-11-03.htm> as retrieved on 11 Jul 2005 16:20:05 GMT.
- (19) Lauterbach followed these impulses like stairs toward something brilliant and sublime. If every choice is an opportunity, it's also a sacrifice. If the poet has any responsibility, it's only to write good poems, which may be what the bartender in that joke is really trying to say: a good poem is one that serves humans, and Lauterbach remembers this again and again.
<http://www.raintaxi.com/online/1997winter/lauterbach.shtml> as retrieved on 27 Jul 2005 08:43:20 GMT
- (20) This property of convexity, associated to the fact that only the lowest level of investment affects the quality is quite interesting. It tells us, at least from an intuitive point of view, that if at least one firm has no incentive to invest then nobody invests. In the opposite case, one would also expect that if every player invests then he spends the largest possible amount of money $\bar{e} = \min_{i \in I} \{\bar{e}_i\}$ on each activity. If one however simply seeks for Nash equilibria of this investment game, one must concede that this intuition is not necessarily true.
<http://www.core.ucl.ac.be:16080/GabsHonor/papers/SoubeyranStahn.PDF>. as retrieved on 17 Jun 2005 17:41:24 GMT.
- (21) Recently economists have considered situations in which the possibility of making a choice in the market changes the behaviour of people. This is known as moral hazard. An obvious example is danger that insurance companies face that people will buy an insurance policy to cover for example a small factory, then deliberately burn it down to claim the insurance. There would be no incentive to burn the factory down unless there was an insurance contract. It is sometimes argued that even if most people don't become criminals then they might be prepared to take more risks if they 'covered' for that risk. Eg will a factory owner be so careful with dangerous machines if he is covered by insurance?
<http://userweb.port.ac.uk/~fyshd/MAP/lect%204.htm> as retrieved on 10 Aug 2005 16:35:47 GMT
- (22) The idea of prices to guide dispatch decisions was introduced to the electricity sector in 1982 by Schweppes. Prices offer a unifying framework for communication, aggregating information in complex systems, and keeping the overall system efficient whilst allowing

for decentralisation of individual decisions. In the energy market prices can be introduced as shadow prices to guide decisions, as audited prices to pay generators based on calculated costs or as market prices. In a perfectly competitive market assuming an infinite amount of buyers and sellers market prices equal variable costs of the most expensive generator required to match demand. If few electricity generators have major market shares then they can execute market power and push prices above competitive levels. Transmission constraints and short-term price inelastic demand increase market power. In European countries other than the Nordic countries market power seems to be ...

<http://www.nautilus.org/DPRKBriefingBook/energy/neuhoff.pdf> as retrieved on 15 Sep 2005 11:40:41 GMT

- (23) We should all agree that root=0, and systems require the "bin" and "daemon" mnemonic user and group names. In retrospect, I guess if few programs/services are hardcoding 1, then they are wrong and specifying bin or daemon equal to 1 would be worse. :-)

<http://lists.debian.org/lb-spec/2002/02/msg00069.html> as retrieved on 17 Jul 2005 18:50:44 GMT.

- (24) Both Brin and Browne are fundamentally wrong. It's just not true that people, even educated people, are inherently likely to achieve a good "consensus" politics. If most people accept the doctrines of socialism, then they will adopt socialism. If they accept some fundamentalist religious dogma, then they will adopt theocracy. Nor is it true that people inherently want to be free. Browne is correct to a certain point: people generally don't enjoy being physically restrained or tortured. But this hardly leads to the libertarian conception of "freedom." People don't have some primal urge to resist paying taxes, abolish the welfare state, etc. Often majorities of voters impose higher taxes. In America, the urge to be free is mostly a cultural leftover from the era of the founders. Soundbites are not sufficient to convert people to the cause of liberty, because political beliefs are rooted (either implicitly or explicitly) in more fundamental theories of the world and of ethics.

<http://www.freecolorado.com/2005/04/lalbrin.html> as retrieved on 8 Aug 2005 09:18:03 GMT

- (25) There's a familiar argument against this point, which goes like this: if most people don't know the difference between may and might, then why bother? But that argument only goes to show how truly stupid Stupidity is. Here's how to counter it: if most people don't know the difference, then they won't object if you use the right word. And the few people who do know the difference will notice, and will be pleased that you've got it right. So by getting it right you please everyone. Who but the stupid would do otherwise?

http://www.la-hq.org.uk/groups/ylg/archive/ylr28_4.htm as retrieved on 18 Jul 2005 01:28:36 GMT.

- (26) A second story is about the Rainbow Bridge (mentioned in my May15 field notes). It is believed that when every Atayal dies, he/she is judged in accordance with the ancient law of Gaga (also known by North Americans as Gaya, the belief in the need for harmony between in all things and people in the universe). If the deceased has lived a 'good' life, he/she will be permitted to cross the Rainbow Bridge (created by the spirit of a famous, kind, fair and honourable Atayal man) to exist with his/her ancestors.

http://marcjintaiwan.blogspot.com/2005_05_01_marcjintaiwan_archive.html

- (27) Malvern Girls' College is situated in one of the most beautiful areas of Britain, at the foot of the Malvern Hills. Founded in 1893, the College enjoys a deserved reputation for excellent academic results. In 2005 the pass rate at A-Level was 99%, with 82% gaining Grade A-B.

The College is committed to providing for the education of the whole person, so when every girl leaves she is well-equipped to fulfil her own individual potential with a sense of social commitment, responsibility and enthusiasm. The Head emphasises that the College caters for a wide range of ability on entry.

http://www.isbi.com/isbi-viewschool/1544-MALVERN_GIRLS_COLLEGE-2.html as retrieved on 28 Aug 2005 00:41:07 GMT.

- (28) "You ever watched the movie 21 grams? I read the book ...it says that when every human dies, he or she will weigh the same. So which weighs 21 grams – is it the breath or the soul of the human? And does soul have any weight?"

http://bunnywunny.blogspot.com/2005_08_01_bunnywunny_archive.html as retrieved on 01 Aug 2005 22:41:20 GMT

- (29) When every kid is freshly diapered he or she is led to his or her cot where a favorite plaything from home awaits. One of the teachers begins cleaning the spills and the other is distributing bottles to those children whose parents give them bottles at naptime. The other teacher is sitting between the kids who have trouble getting to sleep or who occasionally leap from a cot to bite his neighbor (K.). Somebody puts on some sleepy music and we begin patting backs to get them to sleep.

<http://www.thiswomanswork.com/MT/archives/001392.html> as retrieved on 29 Aug 2005 23:03:22 GMT.

- (30) The cost for developing, is relative high for a computer aided course, but this cost is a one time cost and normally the cost is split over a number of years. Of course, this model also has some drawbacks. When every student sits at home she misses the social contact with the other students in the group, but problems are there to be solved and we have a partial solution to this problem. If the students have access to a simple computer communication system where they could send and receive messages to and from teachers and other students in the group, that would improve the group feeling or social contact.

<http://www.cs.umu.se/~bopspe/publications/VUDU/vudumasterthesis.html> as retrieved on 1 Aug 2005 10:19:46 GMT.

- (31) Unfortunately, I think a lot of these so-called terrorists use the Holy War as a kind of ISA. It's just a wrapper that's hiding other agendas.

I hope when every terrorist dies the three women he gets are Salome, Boudicea, and Medusa.

They can serve him. They can serve him his b*****ks on a plate.

It took me an hour and twenty minutes this evening to walk to Liverpool Street.

Not that I'm bitter about it.

[http://www.e-hq.co.uk/mysteria.co.uk/web/cgi-](http://www.e-hq.co.uk/mysteria.co.uk/web/cgi-bin/index.cgi?action=forum&board=media&op=display&num=967)

[bin/index.cgi?action=forum&board=media&op=display&num=967](http://www.e-hq.co.uk/mysteria.co.uk/web/cgi-bin/index.cgi?action=forum&board=media&op=display&num=967) as retrieved on 25 Aug 2005 21:21:33 GMT.